NEW from IRC!

Superior Power Resistor Features in a Low Cost 5-Watt Unit

The new IRC PW-5 Wire Wound Resistor now opens up new possibilities for miniaturization and cost savings in resistance capacitance filters, radio and TV circuits, bridge circuits, attenuator networks, and many other circuits. With this new 5-watt resistor, you can now obtain the superior insulating and high temperature characteristics as found in IRC's famous PW-7 and PW-10 units. The PW-5 also offers you the same extra terminal security resulting from simultaneous assembly of element, leads, and terminal clips in one automatic operation. This latest addition means that you now can specify IRC for all medium power requirements.

LOOK AT THESE FEATURES

- PW-5 saves space... only ¾" x ¾" x ¾"
- PW-5 installs easily... rectangular case with axial leads
- PW-5 covers wide range... from 0.24 ohm to 3300 ohms
- PW-5 stands high temperatures... operates at 60% rated load even at 100° C. ambient
G-V quality at half the cost!

There are many thermal time delay applications for which the high cost of hermetic sealing is unnecessary, but where long life and complete reliability are vital. The new G-V Red Dot is made for these jobs. At half the cost of the well known G-V Hermetically Sealed Thermal Relays you get —

- Rugged, welded stainless steel operating mechanism for reliable operation
- Stainless steel encased heater for long life
- Dust tight metal shell for protection against damage or tampering

RED • DOT
THERMAL
TIMING RELAYS

At half the cost you get G-V's ruggedness, reliability, and long life for no more than you pay for slender, fragile thermal time delay relays.

G-V Red Dot Relays are available from stock in delays of 3 seconds to 3 minutes with heater voltages from 6.3 to 220 volts.

Inquiries welcome; publication $5 for complete sales and prices.

G-V CONTROLS INC.
101 Hollywood Pkwy., Kent, Conn., U.S.A.
MINIATURIZED TRANSFORMER COMPONENTS FROM STOCK

Items below and 650 others in our catalog A.

LEADERS IN
MINIATURIZATION
FOR OVER
TWENTY YEARS...

HERMETIC SUB-MINIATURE AUDIO UNITS
These are the smallest hermetic audios made.
Dimensions ... 1/2 x 11/16 x 29/32 ... Weight 8 oz.

TYPICAL ITEMS

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Application</th>
<th>MIL Type</th>
<th>Pwr. Imp.</th>
<th>Sec. Imp.</th>
<th>DC In Pri MA</th>
<th>Response</th>
<th>Max. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-30</td>
<td>Input to grid</td>
<td>TF1A1Y</td>
<td>50</td>
<td>62.5,000</td>
<td>0</td>
<td>30-10,000+</td>
<td>1-13</td>
</tr>
<tr>
<td>H-31</td>
<td>Single plate to single grid, 3:1</td>
<td>TF1A1Y</td>
<td>10,000</td>
<td>90,000</td>
<td>0</td>
<td>300-10,000+</td>
<td>1-13</td>
</tr>
<tr>
<td>H-32</td>
<td>Single plate to line</td>
<td>TF1A1Y</td>
<td>10,000*</td>
<td>200</td>
<td>3</td>
<td>300-10,000+</td>
<td>1-13</td>
</tr>
<tr>
<td>H-33</td>
<td>Single plate to low impedance</td>
<td>TF1A1Y</td>
<td>30,000</td>
<td>50</td>
<td>1</td>
<td>300-10,000+</td>
<td>1-15</td>
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<tr>
<td>H-34</td>
<td>Single plate to low impedance</td>
<td>TF1A1Y</td>
<td>100,000</td>
<td>60</td>
<td>.5</td>
<td>300-10,000+</td>
<td>1-15</td>
</tr>
<tr>
<td>H-35</td>
<td>Reactor</td>
<td>TF1A2OYY</td>
<td>100 Henrys-0 DC</td>
<td>50 Henrys-5 Ma DC, 4,000 ohms.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>H-36</td>
<td>Transformer interstage</td>
<td>TF1A1Y</td>
<td>25,000</td>
<td>1,000</td>
<td>.5</td>
<td>300-10,000+</td>
<td>1-10</td>
</tr>
</tbody>
</table>

*Can be used with higher source impedances, with corresponding reduction in frequency range and current

COMPACT HERMETIC AUDIO FILTERS

UTC standardized filters are for low pass, high pass, and band pass application in both interstage and line impedance designs. Thirty four stock values, others to order. Case 1-3/16 x 1-11/16 x 1-5/8 - 21/2 high Weight 6-9 oz.

HERMETIC MINIATURE HI-Q TOROIDES
MQE units provide high Q, excellent stability and minimum hum pickup in a case only. 1/2 x 1-1/16 x 17/32 ... weight 1.5 oz.

TYPICAL ITEMS

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Inductance DC Max.</th>
<th>Type No.</th>
<th>Inductance DC Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TF-1</td>
<td>7 mil. 135</td>
<td>TF-18</td>
<td>2-4 mil. 72</td>
</tr>
<tr>
<td>TF-2</td>
<td>20 mil. 80</td>
<td>TF-19</td>
<td>3 mil. 35</td>
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<tr>
<td>TF-3</td>
<td>30 mil. 26</td>
<td>TF-20</td>
<td>4 mil. 17</td>
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<tr>
<td>TF-4</td>
<td>40 mil. 16</td>
<td>TF-25</td>
<td>0.7 mil. 7.2</td>
</tr>
</tbody>
</table>

OUNCER (WIDE RANGE) AUDIO UNITS
Standard for the industry for 15 yrs., these units provide 30,20,000 cycle response in a case 7/8 dia. x 1-3/16 high. Weight 1 oz.

TYPICAL ITEMS

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Application</th>
<th>Pwr. Imp.</th>
<th>Sec. Imp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-1</td>
<td>Mike, pickup or line</td>
<td>50, 200/250, 500/600</td>
<td></td>
</tr>
<tr>
<td>5-2</td>
<td>Single plate to 1 grid</td>
<td>15,000</td>
<td></td>
</tr>
<tr>
<td>5-3</td>
<td>Single plate to 2 grids, 15,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-4</td>
<td>Single plate to line, D.C.</td>
<td>15,000</td>
<td></td>
</tr>
<tr>
<td>5-8</td>
<td>Single plate to line, D.C.</td>
<td>15,000</td>
<td></td>
</tr>
<tr>
<td>5-10</td>
<td>Push pull plates to line</td>
<td>30,000 ohms, plate to plate</td>
<td></td>
</tr>
<tr>
<td>5-12</td>
<td>Mixing and matching</td>
<td>50, 200/250, 500/600</td>
<td></td>
</tr>
<tr>
<td>5-13</td>
<td>Reactor, 300 Hys.-0 D.C., 50 Hys.-3 MA, D.C., 6000 ohms</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HERMETIC VARIABLE INDUCTORS

These inductors provide high Q from 50-10,000 cycles with exceptional stability. Wide inductance range (10-1) in an extremely compact case 25/32 x 1-1/4 x 1-3/16 ... Weight 2 oz.

TYPICAL ITEMS

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<tr>
<td>HVC-1</td>
<td>.020</td>
<td>.006</td>
<td>.020</td>
<td>.10</td>
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<tr>
<td>HVC-2</td>
<td>.020</td>
<td>.006</td>
<td>.020</td>
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</tr>
<tr>
<td>HVC-3</td>
<td>.037</td>
<td>.008</td>
<td>.037</td>
<td>.20</td>
</tr>
<tr>
<td>HVC-4</td>
<td>.025</td>
<td>.006</td>
<td>.025</td>
<td>.15</td>
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<tr>
<td>HVC-5</td>
<td>7.0</td>
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<td>7.0</td>
<td>3.5</td>
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<tr>
<td>HVC-6</td>
<td>50</td>
<td>150</td>
<td>50</td>
<td>1.5</td>
</tr>
</tbody>
</table>

UNITED TRANSFORMER CO.
150 Varick Street, New York 13, N. Y. • EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y.

Editorial

How Big Can Shows Get?

Having just returned foot-weather from the largest electronics show and convention ever held on the West Coast and with the last New York IRE and Chicago NEC show fatigue still vividly in mind, it seems appropriate to ask the question: "How big can a show get?"

There must be a limit. Yet, no limit is in sight on the growth of the mushrooming electronics industry. At the same time, we are rapidly outgrowing facilities available to handle them. Already it is expected that New York's new gigantic Coliseum will be too small to house all prospective exhibitors in next March's IRE Show. Few cities now have sufficient hotel facilities for such shows as IRE and WESCON.

One show official has proposed that exhibitors deploy their show efforts and exhibit at regional shows, rather than always at the "big" ones. Though this might solve the exhibit manager's problems, we doubt the popularity of this suggestion with exhibitors, show visitors, or executives. Exhibitors feel that big shows offer the greatest return for money expended. Visitors and executives cannot be expected to attend numerous shows all over the country each year.

Holding individual shows based on IRE Professional Group interest seems to make some sense as far as technical sessions are concerned. But since the components and equipment usually overlap many Professional Group interests, exhibitors would be burdened with added shows at which to exhibit without any appreciable increase in sales.

The solution to the problem is not a simple one. We propose the formation of an all-electronic industry-IRE committee to make a careful study of the problem and endeavor to find a suitable solution while there is still time to avoid total self-destruction of the "giant." How big can a show get? We must find an answer, and soon.

<CIRCLE 3 ON READER-SERVICE CARD>
Electronic News

One Man Portable TV "Station"

Spot news and other field pickup functions can be telecast with a transistorized 4-pound camera and a 15-pound transmitter developed by RCA's David Sarnoff Research Center in Princeton, New Jersey.

The camera is built around an RCA 1/2 in. Vidicon pickup tube and features an electronic view-finder which can be detached from the camera and hung or strapped around the cameraman's neck and shoulders. Electronically synchronized with the camera, the finder indicates what the camera "sees", even when the camera and its finder are separated physically.

The camera may be hand-held or tripod supported, while the view finder may be separated from the camera and viewed like a reflex camera.

The 2000 mc transmitter operates in the band of frequencies approved by the FCC for this type of operation. The transmitter can be backpacked by one man and is placed in the metal container which also houses a synchronizing generator and battery supply. The transmitter utilized a cavity stabilized triode oscillator. With a power output of 0.5 w, TV signals can be received by a directive antenna at a base station more than a mile away.

The silver cell batteries contained in the 15 pound pack operate the equipment for 5 hours and can be recharged.

Seventy transistors and one transmitter tube, in addition to the pickup and view finder tube, are used.

Electronic Eye Aids Blind PBX Operators

Without modifying existing equipment, an electronic "eye" permits the blind to operate private telephone switchboards. Developed by Bell Telephone Labs., this tiny, thimble-like, light-sensitive phototransistor weighs less than 1 oz.

Heretofore, when a call came into the switchboard, a signal sounded and a lamp lighted. The operator, then, simply plugged a cord into the jack associated with the glowing lamp. A blind operator can now listen for the incoming call signal, and run her finger, which has the "eye" attached to it, across the horizontal row of lights. Upon reaching the lighted lamp, the phototransistor is activated and the operator hears a signal in her headset. The cord which she holds is plugged into the jack associated with the illuminated lamp, thus completing the connection. The operator then determines the extension to which the call is to be made; she picks up another cord paired with the first one and plugs it in to ring the desired extension. The operator knows the location of the extension jacks through familiarity with the switchboard.

For more information on developments described in "Electronic News", write directly to the address given in the individual item.
If your design utilizes an amplifier to boost a minute signal for relay operation — or, if you have 'shelved' some new product idea because the cost, space requirement and other drawbacks of amplifiers made the design impractical — Sensitrol relays are for you. For these tiny, ultra-sensitive relays, which operate direct on input signals as slight as 1 millivolt or 1/2 microampere, and handle substantial wattage at 110 volts, entirely replace amplifiers, vacuum tubes and auxiliary power supplies. They are available with single or double contacts, fixed or adjustable, manual or solenoid reset. For engineering assistance in adapting Sensitrol relays to present products, or new products you have in mind, call your nearest Weston representative, or write for the Sensitrol bulletin B-25-B ... Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.

Produce Electricity From Gases
The "fuel cell," a battery to produce electricity from such gases as hydrogen and oxygen, is presently under study at the Basic Research Labs., National Carbon Co., Parma, Ohio.

The unit would consist of 2 basic unit sections. One section has 2 layers of porous carbon spaced between liquid-paste caustic solution. Oxygen would stream through the space and the molecules would move through the submicroscopic areas in the porous carbon. When the molecules reach the caustic layer, they form a film. Reactions take place which produce negatively charged particles. This is the electron-consuming or "positive" section of the battery. Hydrogen, in a similar way, is used to produce positively charged particles for the "negative" section of the battery.

Nore nickel to industry
Office of Defense Mobilization has ordered 40,000-000 more pounds of nickel be diverted from Govt to industry in 3rd & 4th quarters of this year. The diversion, said ODM director Arthur S. Flemming, will give non-defense consumers more nickel than they obtained during any 1955 quarter or the first quarter of this year.

Computer Solves Problems By Remote Control
Dr. E. L. Harder, director of engineering and service analytical department at Westinghouse Electric Corp., Pittsburgh, indicates that their IBM 704 computer has been already used to calculate atomic reactor power problems, to determine stresses in generator shafts, and to design turbine generators.

By telephone or telegraph, Westinghouse plants in other cities are able to utilize this computer by use of a new "data transceiver." Punch card operated, a private communications network is set up whereby transceiver units link their installation with the centrally located computer.
**Mass Production of New Transistors**

Two new types of transistors, a Micro-Alloy Transistor (MAT) and a Surface-Barrier Diffused Transistor (SBDT), are the direct result of a new manufacturing technique. Developed at Philco's Research Labs, the new devices will be produced by a division of Philco, the Lansdale Tube Co., Spring City, Pa.

The new process avoids the necessity of manually assembling the germanium and the electrode material and alloying them in a furnace. The MAT process uses doped semiconductor layers, only a few millionths of an inch thick and is intended for high speed computer work. The SBDT process subjects tiny germanium transistor blanks to a very carefully controlled atmosphere of metal particles in gaseous form at high temperature. Atoms of the metal, when properly controlled, penetrate the surface of the germanium by diffusion. These latter transistors operate in the uhf range c\(^t\) 500 mc, with a widest use in the 20 to 200 mc range.

**Air Safety & Electronics**

Focus of public and Govt attention is being directed at electronics with perhaps greatest intensity in industry's history—as all responsible officials seek techniques for preventing recurrence of such disasters as recent 2-plane collision over Grand Canyon. As of this writing, near end of Congress' session, President Eisenhower has asked appropriation of an extra $69,043,000 so that Civil Aeronautics Authority can speed air-traffic improvements in anticipation of the even greater needs of jet aircraft. Funds would be in addition to the $40,000,000 already appropriated for that purpose. President's request is part of 5-year plan outlined to Congress earlier this year; it anticipated expenditures of $246,000,000 over the period. Now, however, Secy of Commerce Sinclair Weeks hopes to condense the program into 3 years. If the shocked gravity of Congress is any criterion, Administration will get almost carte blanche to do anything to promote air safety.

... Meanwhile, CAA announced it will study how military's SAGE system of air defense can be integrated with civilian air traffic control to promote efficiency. Study will be conducted by a military integration branch of CAA's Technical Development Center in Boston area. ... Among latest devices aimed at improving air traffic control is Stromberg-Carlson's commercial version of Charactron shaped-beam tube which has been employed in SAGE. The moving diagram provided by the Charactron is exceedingly clear. In addition to indicating the relative positions of the aircraft, and showing movement across a map-diagram, the system actually prints letters and numbers to represent such information as flight number of the plane, speed and altitude.
A new anechoic chamber for research and testing in all phases of acoustics has been completed by Stromberg-Carlson, Rochester, New York.

This facility, designed to exclude all exterior sounds and to eliminate internal acoustic reflections or echoes, will be used for the design, development and quality control studies of high fidelity audio equipment.

Since the chamber stands less than 50 ft from the main line of a railroad, and is close to a heavily-traveled city street, it was necessary to construct a "room within a room". The outer shell of this structure is of high-density concrete blocks. Inside this, separated by several inches of air space, is another room, the walls of which are fabricated of panels of a high-density cement and asbestos composition. This entire internal structure, 25 x 25 x 27 ft, is completely suspended on special vibration-absorbing felt hangers.

The chamber is lined on all sides, including floor and ceiling, with thick glass fiber batts, hung edge-wise to the wall in alternate widths of 1, 2 and 4 ft. A fabric core in the glass fiber material supports the insulating material from the ceiling. A removable open grid of steel serves as the floor. Equipment may be suspended from the ceiling, too.

Isolation For Acoustics

Tunable Maggies Now Stay Tuned

Latest advance in voltage tuning of magnetrons was described recently by scientists of G. E. Research Laboratory, Schenectady, N. Y. In earlier voltage-tunable magnetrons, limitation of space charge was accomplished by the careful regulation of the temperature of the electron-emitting cathode in the tube. Now a new type of grid control and electron injection method has been devised for a "crossed-field beam control system using a space-charge limited emitting source." The result is much greater stability, since the tube operation does not fluctuate with heater power supply variations. It also means longer life because the vulnerable cathode is protected.

The new voltage-tunable magnetron is akin to the new metal and ceramic micro-miniature tubes. It is a stack of four copper bands separated by ceramic disks, the entire tube being less than one-half inch high.

The anode voltage-tuning is virtually instantaneous, it is linear, and it can be performed over a very wide band. Thus, the tube can serve as either a tunable cw or an fm source. In addition, a control electrode permits am modulation and makes pulse modulation feasible. In the novel cathode design, the emitter is placed outside the rf section of the tube. This reduces the detrimental effects of back bombardment present in conven-
Oil Pressure Measuring System

An oil pressure measuring system eliminates bulky and dangerous oil lines in jet aircraft. The system, developed jointly by Thomas A. Edison, Inc., W. Orange, N. J., and Wright Air Development Center, is lighter, more durable, and more accurate than conventional systems.

The new measuring system has only two components, a pressure transmitter mounted on the engine and an indicator in the aircraft's flight compartment. In the transmitter, a metal bar attached to the diaphragm rides in and out of an electrical field as the diaphragm responds to changes in oil pressure. Variations in the electrical field are then translated into readings in the indicator. The transmitter gives accurate oil pressure readings in temperatures ranging from -65 F to 450 F.

SOS SUB SUNK SOS

That's the distress signal rescue stations can receive within minutes after a submarine hits bottom. The transmitter is a radio buoy ejected from the sunken sub.

The unit, developed for the U. S. Navy by the Servo Corp. of America, New Hyde Park, N. Y., is also a beacon that locates the exact position of the distressed craft. It can transmit the message SOS SUB SUNK SOS over a radius of 60 miles at 121.5 Mc. The buoy is three in. in diam and 39.5 in. in length. It has a folding, 20-in. antenna.

The buoy operates on a 5-cell, 7.5-v magnesium silver chloride battery activated by sea water serving as the electrolyte. The instrument can also be dropped by aircraft in distress over water.

El-Menco DUR-MICA Capacitors will match your equipment's life expectancy to at least 15 years!

A recent series of the toughest trials has proved El-Menco DM15, DM20 and DM30 Dur-Mica Capacitors outlast all others. Accelerated conditions of 1 1/2 times rated voltage at ambient temperature of 125° centigrade found El-Menco capacitors still going strong after 10,000 hours. Similar conditions obtaining under normal usage would equal a lifetime of over 15 years!

Tougher phenolic casing means longer life, greater stability, over wide temperature range.

Meet all humidity, temperature, and electrical requirements of both civilian and MIL-C-5 specs.

Parallel leads simplify use in television, electronic brains, miniature printed circuits, computers, guided missiles, and other civilian and military applications.

El-Menco Dur-Mica DM15, DM20, and DM30 Capacitors Assure:

- LONGER LIFE
- POTENT POWER
- SMALLER SIZE
- EXCELLENT STABILITY-SILVERED MICA
- PEAK PERFORMANCE

Tell us your specific needs. Write for FREE samples and catalog on your firm's letterhead.

Take Your Own Word For It. Test El-Menco Dur-Mica Capacitors Yourself.

The Electro-Motive Mfg. Co., Inc.
Willimantic, Connecticut
- molded mica - mica trimmer
- tubular paper - ceramic
ARCO Electronics, Inc., 64 White St., New York, N. Y.
Exclusive suppliers to Jobbers and Distributors in United States and Canada.
Transistor P.A. Mobile Unit

This 4 W mobile transistor public address amplifier, designed to operate from a 12 V battery, has been produced by David Bogen Co., Inc., New York 14, N.Y.

Model BT12 is compact, lightweight and mounts easily under a dashboard. On the front panel are the connections or controls for microphone, speaker, fuse, volume control and power on-off switch.

Ceramics Made Heat and Chemical Resistant

"Flame Ceramics," a novel method of coating metals and other substances with ceramic materials, has been developed at Armour Research Foundation of Illinois Institute of Technology.

This flame spray technique makes it possible to cover rockets and missiles with a protective coating able to withstand high temperatures. During testing, it was noted that the underlying metal actually melted without causing coating failure.

The sprayed composition is a powder usually composed of an alumina or zirconia oxide with other necessary additives to give the desired coating. The powder, contained in a hopper, is blown through a flame torch. Surfaces to be coated are sand or grit blasted. Non-metals need not be sandblasted but should be cleaned thoroughly. Material to be coated does not require high preheating.

Continental Coatings Corp., Chicago, has been granted world-wide rights to this process.
Stevens Institute Offers
Computers Courses

Leading to the degree of Master of
Science, a graduate program in the
design, selection and operation of
computers will be inaugurated this
fall at the Stevens Institute of Tech-
nology, Hoboken, N. J. To be made
available to full-time industry em-
ployees, classes will be held two
nights a week for three years, begin-
ing September 24, 1956.

Graduates of the new program will
be able to design and build computers
for special requirements as well as
make selections from among standard
models. Graduates will also be able
to prepare the information to be fed
to the machines.

In the first year of the three-year
program emphasis is given to mathe-
matics and to the study of electrical
circuits, while in the second year the
program is concentrated on thorough
study of the two general classes of
computers: analog and digital. In
another second year course the methods
of planning and control in the indus-
try are also considered.

In the final year the program covers
linear programming, a key to au-
tomated production, and the pro-
gramming or preparation of information for
computing devices. During the last
year students will also learn to use
the specialized mathematical tech-
niques grouped under the theory of
games, and will review case studies
of current computer practices.

Applications for admission to the
computer program are being accepted
from college graduates with a degree
in engineering, mathematics or the
physical sciences.

Littelfuse Installs IBM Equipment

The installation of a full comple-
ment of IBM equipment to handle
automatically the hundreds of orders for
fuses received daily from electronic,
automotive, and military fields has
been completed at the Des Plaines,
Ill. offices of Littelfuse Inc.

Customers are assured efficient and
rapid service on orders. All paper
work is handled by an automatic pro-
cedure which accelerates and expe-
idites the movement of customers' orders through the plant.

CIRCLE 9 ON READER-SERVICE CARD
Extremely Versatile... Unusually Adaptable

Used with the Lavoie LA-61 Frequency Meter, the LA-18 can easily measure from 500MC to 35,000MC with .001% accuracy.

Used with the Lavoie LA-61 Frequency Meter and the LA-800 WWV Comparator, the LA-18 becomes the Model LA-670 Microwave Frequency Standard.

Send for brochure on the LA-18 and the name of our nearest engineer representative who will arrange a practical demonstration AT YOUR PLANT—to suit your convenience.

Atomic Power Engine Runs 66 Days
The US Atomic Energy Commission recently announced that the land-based prototype of the submarine Nautilus at the National Reactor Test Station in Idaho was routinely shut down, completing what is believed to be the longest (1600 hours), continuous, full power run ever completed by any type of propulsion plant.

The test proved the reliability and stamina of pressurized water reactors for ship propulsion. US Navy officers and men, who formed part of the personnel complement during the tests, will man future atomic power ships of the fleet.

Solving the Scientific Manpower Shortage
James O. Bengston, president of Chicago Apparatus Co., a supplier of scientific instruments, indicated recently that laboratories are generally far ahead of other sections of the industrial plant in making efficient use of manpower.

With the view toward freeing professional workers from non-technical details, the laboratory's ratio of supporting personnel to scientists has increased from 0.75 to 1.09 during the past 5 years. This ratio can be interpreted as increasing scientific manpower by 45 per cent.

NY Coliseum—Well Wired for Sound
The New York Coliseum, the nation's largest exhibition building for trade shows and fairs, is using a four-in-one RCA industrial sound system to provide exhibitors with service in all sections of the $35,000,000 structure.

The installation, planned and installed by Commercial Radio Sound Corp., New York, incorporates 4 separate sound systems, one for each exhibition floor.

Each floor has its own self-contained control system. The floors are divided into 4 separate sound zones, and programs originating from any zone on any floor can be confined to that zone, distributed to all zones on the same floor, or transmitted to any or all zones on other floors of the Coliseum.

< CIRCLE 10 ON READER-SERVICE CARD
Imported TV Camera

“Peepsqueek,” the cigar-shaped TV camera, manufactured in West Germany by Grundig Radio-Werke GmbH and marketed in the U.S. by Majestic International Corp., Chicago 10, Illinois, is less than 6 in. long and has a 1-7/8 in. diameter.

Equipped with two sets of spring-loaded guide rollers, the camera can pass through pipes, or other access orifices whose ID match the camera diameter.

This remote-controlled unit contains a mini-resistor and a number of subminiature tubes that serve as amplifying elements. A conical mirror accessory may be mounted 3/4 in. ahead of the lens combination to reflect the image of inside walls. The image received can be magnified up to 20 times since the focal length of the lens system is only 1/2 in.

Nuclear Training for College Faculty

Responding to demands for nuclear training far beyond the capacity of the original summer school for engineering college faculty members at Argonne National Lab., a second school has been scheduled. The supplementary institute will be conducted at Brookhaven National Lab., Upton, L.I., N.Y.

Sponsored jointly by the Atomic Energy Commission, the National Science Foundation, and the American Society for Engineering Education, the Brookhaven program will accommodate 50 additional candidates. They have been selected from 22 institutions in 15 states.

Basic aim of both schools is to expand the number and scope of engineering course offerings in atomic and nuclear fields. ASEE gives overall supervision and makes final candidate selections.

Science has a new kind of space man these days. He carries a brief case.

His mission is as new, as exciting and as challenging as a trip to the moon. In many cases you'll find him on the team at Remington Rand Univac®, one of the engineers or technicians who have given UNIVAC the title,

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**IMMEDIATE OPENINGS FOR:**

At South Norwalk we have immediate openings for Mechanical and Electro-Mechanical Engineers, with a bachelor's degree in Engineering. Extensive mechanical design background may substitute for some college. Men selected will do basic preliminary design and layout of small mechanisms. Work will be done on original ideas and the ability to apply logical analysis to design problems.
New Air Force Navigational Trainer

Thirteen navigator-students can be trained simultaneously in a series of identical booths, each containing all the necessary equipment which the navigator would normally have during an actual flight.

Developed and manufactured as the N-3 Navigational Flight Simulator for the USAF by Reflectone Corp., Stamford, Conn., each booth is individually controlled by an instructor-operator from a central console where an infinite variety of simulated flying conditions can be established. Meters display, "live" radio communications, and UP-2 Charts lend realism.

Mounted on the back of each booth is a large, ground-glass panel having a UP-2 Chart which can be marked by the instructor. Controlled by an analog computer, a stylus traces each student's flight pattern. Comparison of this chart with the student's own plot can be made at the end of the "flight".

Proportioning Panel Records Formulas on Punch Card

An electronically controlled proportioning system automatically records formulas and weighings on a summary punch card by means of a recording device interlocked with the action of the panel. The system combines the automatic proportioning features of a control system with a printing summary punch. Information is transmitted by means of digitizing equipment, which digitizes individual weighing and sends the information to a summary punch.

The equipment, made by Richardson Scale Co., Clifton, N. J., is designed for full-automatic or semi-automatic operation. The equipment may be used to process billings, maintain inventory control and keep records of weighing and proportioning.

Oxidation-Hardenable Silver Alloy

A silver-magnesium-nickel alloy (99.027, 0.20 per cent respectively), developed by Handy and Harman, 82 Fulton St., New York 38, N. Y., has the property that it is easily worked while soft and then can be irreversibly hardened by heating in air.

Once hardened, this silver alloy has a low creep rate and for all practical purposes does not anneal at elevated temperatures. Annealing, however, can be done in air at 700 F or in a non-oxidizing atmosphere above 700 F.

Suggested applications for this alloy: electrical contacts which can be attached by brazing without loss of hardness; shields and clips for vacuum tubes requiring high thermal conductivity; instrument and relay springs; contact arms; wipers and sliders requiring high conductivity and hardness at elevated temperatures.
Washington Report

Albert Warren

Washington Trends & Briefs

“Very favorable” is how Secy of Commerce Sinclair Weeks characterizes outlook for electronics in second half of 1956. He expects factory volume for full 1956 to reach $6.8 billion, up 8% from last year... Radiation limits for community antenna TV systems have been formally established by FCC as follows: under Ch. 2, 15 µv/m at 100 ft.; Ch. 2-6, 20 µv/m at 10 ft (400 µv/m in sparsely populated areas); Ch. 7-13, 50 µv/m at 10 ft (1000 µv/m in sparsely populated areas); above Ch. 13, 15 µv/m at 100 ft. New systems built after Oct. 1 must comply with specifications from start. Existing systems must comply by Dec. 31, 1959... Police TV microwave system, first of its kind, has been authorized by FCC to State of Ohio Dept. of Highway Safety. System will operate between Bureau of Automobile Licensing & Records Bldg. and State Highway Patrol headquarters, both in Columbus, giving quick visual access to auto registration data.

Patents... Atomic Energy Commission, continuing policy of releasing non-secret patents for licensing to industry, recently released 18 in electronics covering following devices: amplifier circuit, current measuring device, alpha survey meter circuit, neutronic reactor measuring and safety rod operating apparatus, fluid cooled neutronic reactor, portable scintillation survey meter, demountable filament assembly, submerged reactor, reactor, electrolytic cells, electronic analyzer, magnetic field measuring device, binary counter, ion producing mechanism, beam current regulator, arc regulator for calutron source, calutron receivers, power of voltage measuring means. Information on these and other AEC patents may be obtained from Chief, Patent Branch, Office of General Counsel, AEC Washington 25, D.C. New patent index is service offered by Information for Industry Inc., 1108 16th St. NW, Washington. Published annually, the “Uniterm” index breaks patents down into key words for easy search by designers, patent attorneys, etc. First volumes cover the 3130 electronic patents issued in 1955, but consideration is being given to indexing those issued during 1950-54. Analysis of 1955 patents shows that about 10% were assigned to U.S. Govt. Next largest assignees: RCA, 262; Bell Labs, 170; GE, 118; Westinghouse, 85; T& T, 51; Bendix Aviation, 50; Raytheon, 44; Stromberg-Carlon, 32; IBM, 30; DuMont, 29; Sperry Rand, 26; Collins, 24; Philco, 23; Motorola, Sylvania & Hughes Aircraft, 22 each; Phillips Petroleum, 19.
This new self-contained 8-channel oscillographic recording system, primarily for analog computer recording, measures only 46½” x 27” x 22”. In a single, space-saving mobile package, the user has a complete system for analog computer readout recording. Input cable connections are easily made at the top of the back panel. Eight groups of controls for the eight channels are conveniently located on the sloping top panel. Driver Amplifier chassis are easily withdrawn from the lower part of the console for inspection. Paper loading is quickly done from the top.

Features of the Model 158-5490 system include 0.1v/cm to 100v/cm sensitivity; over-all linearity of 0.25 mm over the entire 4 cm of the chart; drift less than 0.5 mm/hour; push-pull or single-ended input; miniaturized dual-channel DC amplifiers of improved current feedback design; 5 meg. input impedance each input lead to ground; true rectangular coordinate recording; nine chart speeds from 0.25 to 100 mm/sec. Frequency response is flat to 20 cps, down 2 db at 60 cps for all amplitudes to 4 cm peak to peak.

Letters to the Editor

Dear Sir:

We were very pleased with the appearance of our article in the July 15th issue of ELECTRONIC DESIGN. Permit us to congratulate you on what we consider to be an excellent job of editing and layout. However, we detected a few minor errors (in the article “Design Considerations for Semiconductor Power Supplies”) which we should like to call to your attention.

On page 23 in the Editor’s Note . . . equations . . . should only refer to the circuit of Fig. 1; . . . the implication is that they refer to all the circuits. . . . In line 6 of the right hand column, page 23, the phrase should read “for \( R_L/R_B > 1 \), usually \( R_L/R_B \) and \( R_L/R_C < 1 \).” (The “1” following the “less than” symbol is missing in the article.) . . . In line 5 on page 25, the . . . statement is (made) “a second transistor is paralleled across the original one.” . . . (more accurately) “a second transistor is cascaded in the complementary connection to the original one.” . . . (In the heat sink discussion \( \Delta t \) was not defined.) \( \Delta t \) may be defined as the drop between the dissipator and the ambient and is equal to \( PR_{th} \) in Fig. 7.

S. Sherr, Section Head
General Precision Laboratory Inc.

We thank Mr. Sherr for calling these corrections to our attention. We hope the above will clarify any misconceptions that may have been conveyed to our readers. Ed.

Dear Sir:

We have just had the pleasure of reading a copy of your July 15, 1956 issue of ELECTRONIC DESIGN. However, we are sorry to note in the article entitled “Patents,” by John Montstream, that on page 90 in the section describing Patent No. 2,736,000, our trade-mark, “Fathometer,” has been misused as though it were a generic term for depth sounders.

We must point out that “Fathometer” is a registered trade-mark belonging exclusively to Raytheon...

SANBORN COMPANY
INDUSTRIAL DIVISION
195 MASSACHUSETTS AVE., CAMBRIDGE 30, MASS.
and can be correctly used only in connection with our Company and the Submarine Signal Co., our predecessor in the depth sounder business, for nearly 30 years.

We realize, of course, that the misuse may have been due to similar misuse in the referred to patent. This misuse in the patent has been brought to the attention of the Commissioner of Patents, who has assured us that steps are being taken to rectify the situation. However, in order to protect a valuable property right belonging exclusively to the Raytheon Manufacturing Company, it is necessary that we call this matter to your attention, and ask your cooperation...

Gerald Singer, Patent Solicitor
Raytheon Mfg. Co.

Mr. Singer's letter speaks for itself. Ed.

Dear Sir:

Your readers may be interested to learn that the Russian-made Thermocouple generator, described on page 83 of your May 1st issue, is exactly like four such generators which I made in 1923, and which I still have. These were heated, either by flame lamp, or by an internal resistance wire, fed by a.c. house current. Mine used iron-constantan junction elements, and developed 6 w at 6 v and 1 a in an external load.

Benjamin Franklin Miesner
Morristown, N. J.

It may be of interest to our readers to learn that a new model of a thermo-couple power pack for battery operated receivers, energized by kerosene, is reported in the February, 1956, issue of the Russian publication Radio. It is known as the Model TEGK-2-2 and differs from the earlier model in that 24 voltages is generated directly, without a vibrator. A substantial reduction in the noise level results, according to the claims made. Ed.

Why Corning High-Power, High-Frequency Resistors meet your most exacting circuit requirements

You'll find Corning High-Power and High-Frequency Resistors designed for stable, long-life service—even under the most difficult operating conditions.

With Corning Resistors you get the highest resistance range for a given physical size compared to wire-wound resistors.

Their thin-film construction makes them inherently non-inductive. The noise level of these resistors is so low it's difficult to measure. The resistive film is a metallic oxide, fused to the Pyrex glass core at red heat to form a permanent bond. This special glass insures highest core resistivity even at elevated temperatures, great resistance to chemical attack and to mechanical and thermal shock.

These Corning Resistors are remarkably stable regardless of moisture and humidity.

The chart in the next column gives you a quick idea of their exceptional frequency characteristics.

The ranges and ratings shown in the illustration are for our standard lines, but we can design and build resistors to match your own requirements for all usable frequencies. We've made specials with ratings up to 150 kw, and we can go higher.

Within the standard range of these resistors, we can give you wide variations in mounting hardware. You can get hardware for vertical or horizontal mountings and mountings to absorb mechanical shock and severe vibration. Ferrule-type terminals are available for use with standard fuse clips.

Our catalog sheets give far more complete details than we are able to here. We'll be glad to send you copies with current price lists.

**Other products for Electronics by Corning Components Department:** Fixed Glass Capacitors, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traversal and Midget-Rotary Capacitors, Metallized Glass Inductances, Attenuator Plates.

*Distributed by Erie Resistor Corporation*
New copper-clad MICARTA®
takes dip solder bath without blistering!

New H-3032 copper-clad MICARTA® cuts costs and production time of printed circuits. Copper-clad MICARTA speeds up soldering, without the normal accompaniment of an increase in rejects and missed connections. It can be cold punched without cracking or chipping.

The laminate won't blister even when dip soldered for 10 seconds at 500°F! Examine the two close-up photographs. One shows an ordinary laminate after a laboratory test. Note the blistering, then look at the MICARTA dip soldered for the same length of time—and there is no blistering!

A special adhesive is used which has the same high electrical properties, solvent resistance and low moisture absorption as the MICARTA laminate itself. Actually, adhesive strength is increased during soldering.

Because of a new adhesive process, copper-clad MICARTA keeps its high bond strength—from 10 to 13 pounds versus an industry standard of six pounds—even after heating and cooling is repeated many times. This is especially valuable for electronic circuits.

Copper-clad MICARTA may be the answer to your circuit assembly problem. Write for further information and technical data to Westinghouse Electric Corp., MICARTA Div., Hampton, S. C., 7-06624
Oct. 3-5: Fifth Annual Meeting of the Standards Engineers Society.
Willard Hotel, Washington, D.C. Topics expected to be of particular interest to standards engineers in the electronic field are the session devoted to "Dynamic Standards for the Median Company" and the session devoted to "Drawing Practice Standardization." Additional information may be obtained from the Washington Section, Standards Engineers Society, 4042 N. 35th Street, Arlington 7, Va.

Oct. 8-9: Second Annual Symposium on Aeronautical Communications.
Hotel Utica, Utica, N. Y. Sponsored by the IRE Professional Group on Communications Systems. The symposium will stress communication requirements in support of present and future aeronautical activities. For additional information, write to R. C. Benoit, Jr., 138 Riverview Parkway N., Rome, N.Y.

Oct. 8-12: Society of Motion Picture and Television Engineers Convention.
Los Angeles, Calif. A technical session will be devoted to a program of papers on transistors and their applications to motion pictures and television. For additional information, write John B. Olsson, Houston-Fearless, 11801 W. Olympic Blvd., Los Angeles 64, Calif.

Morrison Hotel, Chicago, Ill. Sponsored by the Armour Research Foundation of Illinois Institute of Technology. For information, contact J. J. Koval, Conference Secretary, Armour Research Foundation of Illinois Institute of Technology, 10 W. 35th St., Chicago 16, Ill.

Hotel Statler, Boston, Mass. Sponsored by the AIEE, IRE, American Physical Society, American Institute of Mining and Metallurgical Engineers. For further information, write to T. O. Paine, Measurements Laboratory, General Electric Co., W. Lynn, Mass.

Sheraton Gibson Hotel, Cincinnati, Ohio. For information, write to AIEE, 33 W. 39th St., New York 18, N. Y.

Shoreham Hotel, Washington, D. C. For information, contact Prall Culviner, Sylvania Electric Products, Inc., 1740 Broadway, New York, N.Y.
The formula for success in the field of electronics might be resolved to the equation, "Scientific ability plus engineering skill plus modern plant facilities equals achievement." You will find all three behind these doors of Marvelco Electronics. Scientific ability represented by some of the finest electronic scientists in the nation... dedicated scientists whose research not only has produced such achievements as the Tandem Transistor, but practical scientists who have the ability to apply the fruits of their research to industry. They are backed up by skilled engineering technicians working with modern production facilities to make their formulas a finished product. If you have an electronics problem or a research and development project why not query Marvelco today?

Behind these doors...

The formula for success in the field of electronics might be resolved to the equation, "Scientific ability plus engineering skill plus modern plant facilities equals achievement." You will find all three behind these doors of Marvelco Electronics. Scientific ability represented by some of the finest electronic scientists in the nation... dedicated scientists whose research not only has produced such achievements as the Tandem Transistor, but practical scientists who have the ability to apply the fruits of their research to industry. They are backed up by skilled engineering technicians working with modern production facilities to make their formulas a finished product. If you have an electronics problem or a research and development project why not query Marvelco today?

MarVelco
(Electronics Division)
Du Pont "Mylar" polyester film is now available for a wide variety of electrical insulating uses, some of which are illustrated above. These laminates offer superior performance... make possible important space savings. That's because laminates with "Mylar" provide exceptionally high dielectric strength and heat stability... plus remarkable resistance to moisture and many chemicals.

While those types listed on the right are basic, there are numerous other combinations of "Mylar" available, depending on specific needs. So check your supplier today. It will pay you to investigate the new combinations of "Mylar" in his line. Or send in the coupon below for names of converters who manufacture electrical laminates with "Mylar". Be sure to mention the specific application you have in mind.

*Du Pont manufactures the basic material "Mylar"—not finished electrical laminates. "Mylar" is Du Pont's registered trademark for its brand of polyester film.

**Mylar** to paper. Basically, there are two primary advantages of this laminate... high dielectric strength at lower cost and good cutting characteristics in thinner gauges. That's because thinner gauges of "Mylar"—strongest of all plastic films—can be used.

**Mylar** to glass cloth. Because "Mylar" remains dimensionally stable from -60° to 150° C., "Mylar" laminated to glass cloth offers superior insulation at both high and low temperatures. In addition to high flexibility, this laminate has good forming characteristics in thinner gauges.

**Mylar** to asbestos. Excellent for motors and generators operating in the Class "B" temperature range. Coated asbestos laminated to this tough polyester film produces a stronger product with increased moisture resistance.

**Mylar** to micro. This laminate offers maximum insulation plus flexibility. In short, micro is easier to work with when laminated to "Mylar". Costs are lower too because thinner gauges of micro can be used... Du Pont "Mylar" gives the micro "body."
MODERN synthesis techniques have shown how to design ladder networks with the minimum possible number of elements. Three of the characteristics used in synthesis are obtained from Butterworth, Tschebyscheff, and Bessel polynomials; the first gives a maximally-flat magnitude characteristic, the second an equal-ripple magnitude characteristic, and the third a maximally-flat time delay. In this series of articles tables are presented which give the element values of normalized low-pass ladders having these characteristics; these ladders may be resistance terminated at one end or at both ends. By means of frequency transformations the low-pass characteristic may be converted to serve a high-pass, band-pass, or band-elimination function. The tables make it possible for the design of the networks to be accomplished in handbook fashion.

Scope

The design of networks by modern synthesis techniques is now highly developed. These techniques have a great deal to offer the practical engineer who wants to build optimum networks to satisfy his requirements. However, most of the theory appears formidable to many engineers, and as a consequence networks (filters, time-delay networks, equalizers, etc.) are being used which are inefficient or uneconomical.

In the tables that follow, the three large classes of networks can be designed. By means of these tables the engineer who knows little about the theory of modern synthesis can synthesize useful networks without the necessity of carrying out laborious calculations or plowing through a mass of theory. It is fortunate that for a large class of problems the results can be given in handbook form.

Because of space restrictions only an outline of the theory for each type of network is presented; the interested reader can consult the references for additional details. However, it is believed that sufficient theory is given to acquaint the reader with the characteristics of the networks whose element values are given in the tables.

The paper is divided into a four part series. The first two will treat Butterworth and Tschebyscheff networks, respectively, while the third part treats the maximally-flat time-delay networks obtained by the use of Bessel polynomials. In each of these three parts tables of the element values of the normalized low-pass ladder network are given. In the final part it is briefly shown: a. how to transform these networks to serve high-pass, band-pass, or band-elimination functions; b. how to remove the normalization of the element values; that is, how to change the pass band of the network from ω = 1 to the desired radian frequency, and how to raise the level of the network; c. how to use duality and reciprocity to obtain sets of new networks; d. how to convert the symmetrical Butterworth and Tschebyscheff networks to unsymmetrical ones with any desired ratio of input to output resistance.

Which Network To Use

If a filter is required whose magnitude characteristic is specified, then the Butterworth or Tschebyscheff characteristic may be used. For the same value of n, the Tschebyscheff filter gives a better coverage of the pass band and a faster drop-off outside the band than any other possible transfer function that is also a constant divided by a polynomial; its phase characteristic, however, is more nonlinear than that of the Butterworth filter. Thus the choice between the two will depend on the importance of the phase characteristic. Neither of these filters gives a linear phase characteristic, that is, a pure time delay, over a specified frequency range. For this purpose the Bessel polynomials are used. The filters obtained by use of the Bessel polynomials also have a low-pass magnitude characteristic so that they may also be used in those problems where the magnitude characteristic is specified.

Use of the Tables

The general form of the low-pass ladder network whose element values are given in the tables is a lossless network terminated in resistance. In all the tables and in the figures the element values are given in ohms, henrys, and farads. One table gives the values for a resistance termination at the output end only. For networks with resistance terminations at both ends, a number of tables are necessary, each table corresponding to a different ratio of input to output resistance; often a desired ratio of input to output resistance (rather than decrement) is desired, and it is shown how to use the Butterworth and Tschebyscheff tables (for n odd) to achieve any desired ratio.

Modern Synthesis

Network Design From Tables – I

Louis Weinberg, SS Engineer
Hughes Research Laboratories Co., Culver City, Calif.

The element values are normalized in that the pass band has a cutoff radian frequency ωc equal to unity and the network has a one-ohm resistance load, i.e. in all the tables R1 = 1. As will be shown in Part IV the removal of these normalizations requires only simple multiplications. The examples, also, will show how to remove normalizations.

Two general types of inputs are used in practice, a current-source input or a voltage-source input. The circuits for the general ladder, with resistance terminations at both ends and with a current-source input, are shown in Fig. 1-1. The transfer function realized by these networks is the transfer impedance Z21 = E2/E1.

It is observed that both a and b of the figure have a shunt capacitance at the load end; in addition, the a network, which occurs for n odd, has a shunt capacitance at the input end also, whereas the b network, which occurs for n even, has a series inductance at the input end. When the table for a resistance termination at only one end is used, Rn is not present, that is, Rn is infinite.

For a voltage source used as the input, the dual of the above networks applies. The general networks are shown in Fig. 1-2. Here a occurs for n odd and b for n even. The transfer function realized by these networks is the transfer admittance Y21 = I2/I1, i.e. using the table for the resistance termination at only one end, Rn is zero.

For networks with resistance terminations at both ends, the unprimed elements in the tables correspond to the current-source input networks, Fig. 1-1. The primed elements correspond to the voltage-source input networks, Fig. 1-2. However, this is not true when the network is terminated by a resistance
only one end, i.e., when the decrement ratio \( D = 0 \). In this case the unprimed elements correspond to \( Z_{2i} \), (i.e., to a current-source input) only for \( n \) odd; for \( n \) even the unprimed elements correspond to \( Y_{2i} \). The primed elements play the reverse roles: they correspond to \( Y_{2i} \) for \( n \) odd and to \( Z_{2i} \) for \( n \) even.

For all the low-pass and high-pass transfer functions the number of reactive elements in the network realizations is equal to \( n \), the degree of the denominator polynomial. This is the minimum possible number that can be used to realize these functions.

The tables for the Butterworth and Tschebyscheff networks are organized on the basis of the decrement ratio \( D \). However, it is possible by use of the tables to obtain any desired resistance ratio for networks using odd values of \( n \). Examination of the tables for \( D = 1 \) shows that the networks are symmetrical for odd; that is, they are mirror images with respect to the vertical center line and thus may be broken into two halves as shown in Fig. 1-3 (where a current input has been assumed). Each half has the same transfer impedance and, as seen from the center line, the same driving-point impedance \( Z_o \). To achieve a resistance ratio \( r = R_o / R_1 \) other than unity is simply accomplished: the impedance level of the network on the left is changed by the factor \( r \). In this way any desired resistance ratio may be realized; i.e., a whole class of new networks is obtained. It will be shown in Part IV that this level change of half of the network does not change the shape of the frequency variation of the over-all transfer function but merely changes its constant multiplier.

### Steps in Solving Problems

1. Determine from the specifications of the problem whether a Butterworth, Tschebyscheff, or Bessel polynomial network is to be used.

2. Calculate the value of \( n \) that gives the required degree of the denominator polynomial of the transfer function and consequently the required complexity of the network. For the Tschebyscheff characteristic \( D = 1 \) it is first necessary to calculate the ripple factor \( \varepsilon \). Method of calculating \( n \) or \( \varepsilon \) is shown in respective sections.

3. Using this value of \( n \) look up the element values in the appropriate table. For the Butterworth and Tschebyscheff filters a decrement ratio \( D \) is specified for each table. The parameter \( D \) equals \( d_i / d_a \), the ratio of the input to the output decrement. The decrement is defined in the usual way as the reciprocal of the characteristic constant; for a capacitance at the output \( d_i = 1 / R_1 C_1 \), since \( R = 1 \); for an inductance \( d_i = 1 / L_1 \). Similarly for the input decrement \( d_a = 1 / R_a L_a \). As explained previously, for current-source terminations at both ends, the unprimed values in the tables correspond to a current input, whereas the primed values correspond to a voltage input. For a resistance only at the load end, however, the unprimed values correspond to a current input for \( n \) odd and to a voltage input for \( n \) even.

![Fig. 1-1 General forms of low-pass ladder network with a current-source input and resistance terminations at both ends.](image1)

![Fig. 1-2 General forms of low-pass ladder network with a voltage-source input and resistance terminations at both ends.](image2)

![Fig. 1-3 Decomposition of a symmetrical network into two network halves.](image3)
Table I.1  Element Values (in ohms, henrys, farads) for a Normalized Butterworth Filter

| Value of n | \(C_1\) or \(L_1\) | \(C_2\) or \(L_2\) | \(C_3\) or \(L_3\) | \(C_4\) or \(L_4\) | \(C_5\) or \(L_5\) | \(C_6\) or \(L_6\) | \(C_7\) or \(L_7\) | \(C_8\) or \(L_8\) | \(C_9\) or \(L_9\) | \(R_n\) or \(1/R_n\) |
|-----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| a) \(D = 0\) (For this case unprimed values correspond to a current-source input for \(n\) odd and to a voltage-source input for \(n\) even.) |
| 1 | 0.7071 | 1.414 | |
| 2 | 0.5000 | 1.333 | 1.500 |
| 3 | 0.3827 | 1.082 | 1.577 | 1.531 |
| 4 | 0.2588 | 0.8944 | 1.382 | 1.694 | 1.545 |
| 5 | 0.1951 | 0.5776 | 0.9370 | 1.259 | 1.729 | 1.825 | 1.561 |
| 6 | 0.1564 | 0.4654 | 0.7626 | 1.041 | 1.292 | 1.510 | 1.687 | 1.812 | 1.855 | 1.564 |
| b) \(D = 1/2\) |
| 1 | 1.500 | |
| 2 | 1.051 | 1.697 |
| 3 | 0.7500 | 1.846 | 1.393 |
| 4 | 0.5760 | 1.557 | 1.974 | 1.120 |
| 5 | 0.4635 | 1.307 | 1.880 | 1.902 | 0.9194 |
| 6 | 0.3082 | 1.117 | 1.694 | 1.983 | 1.771 | 0.7743 |
| 7 | 0.2364 | 0.9697 | 1.122 | 1.405 | 1.788 | 1.965 | 1.980 | 1.770 | 1.269 | 0.4693 | 1.000 |
| c) \(D = 1\) (\(R_n\) or \(R_n^{-1}\) for all values of \(n\)) |
| 1 | 2.000 |
| 2 | 1.414 | 1.414 |
| 3 | 1.000 | 2.000 | 1.000 |
| 4 | 0.7654 | 1.848 | 1.848 | 0.7654 |
| 5 | 0.6180 | 1.618 | 2.000 | 1.618 | 0.6180 |
| 6 | 0.5176 | 1.414 | 1.932 | 1.932 | 1.414 | 0.5176 |
| 7 | 0.4450 | 1.247 | 1.802 | 2.000 | 1.802 | 1.247 | 0.4450 |
| 8 | 0.3902 | 1.111 | 1.663 | 1.962 | 1.962 | 1.663 | 1.111 | 0.3902 |
| 9 | 0.3473 | 1.000 | 1.532 | 1.879 | 2.000 | 1.879 | 1.532 | 1.000 | 0.3473 |
| 10 | 0.3129 | 0.9080 | 1.414 | 1.782 | 1.975 | 1.975 | 1.782 | 1.414 | 0.9080 | 0.3129 |
| d) \(D = 2\) |
| 1 | 3.000 |
| 2 | 2.121 | 0.8485 |
| 3 | 1.500 | 1.714 | 0.8077 |
| 4 | 1.148 | 1.926 | 1.596 | 0.5600 |
| 5 | 0.9270 | 1.886 | 1.895 | 1.296 | 0.4674 |
| 6 | 0.7764 | 1.766 | 1.989 | 1.689 | 1.120 | 0.3872 |
| 7 | 0.6676 | 1.628 | 1.984 | 1.887 | 1.516 | 0.9704 | 0.3341 |
| 8 | 0.5853 | 1.496 | 1.931 | 1.974 | 1.755 | 1.361 | 0.8581 | 0.2925 |
| 9 | 0.5209 | 1.376 | 1.855 | 1.996 | 1.892 | 1.619 | 1.231 | 0.7673 | 0.2605 | 0.9999 |
| 10 | 0.4693 | 1.269 | 1.770 | 1.980 | 1.965 | 1.788 | 1.495 | 1.121 | 0.6937 | 0.2346 | 1.000 |
| e) \(D = 3\) |
| 1 | 4.000 |
| 2 | 2.828 | 0.5657 |
| 3 | 2.000 | 1.333 | 0.8571 |
| 4 | 1.531 | 1.702 | 1.605 | 0.4502 |
| 5 | 1.236 | 1.834 | 1.874 | 1.107 | 0.4386 |
| 6 | 1.035 | 1.862 | 1.978 | 1.509 | 1.036 | 0.3345 |
| 7 | 0.8901 | 1.786 | 2.008 | 1.747 | 1.401 | 0.8561 | 0.3014 |
| 8 | 0.7804 | 1.704 | 1.998 | 1.882 | 1.635 | 1.222 | 0.7727 | 0.2581 |
| 9 | 0.6946 | 1.611 | 1.965 | 1.954 | 1.787 | 1.477 | 1.114 | 0.6824 | 0.2324 | 0.9961 |
| 10 | 0.6257 | 1.519 | 1.917 | 1.985 | 1.885 | 1.656 | 1.363 | 1.006 | 0.6200 | 0.2082 | 0.9980 |

4. If the network realizes a Butterworth or Tschebyschew characteristic and is symmetrical (i.e., \(D = 1\) and \(n\) is odd), and if a non-unity resistance ratio \(r = R_n/R_t\) is desired, multiply the impedance level of the left half of the network by \(r\), as shown in Part IV.

5. Remove the normalizations as shown in Part IV. The bandwidth is thus changed from \(\omega_c = 1\) to the desired cutoff value, and the load resistance and the network level are changed to the required values.

6. If a high-pass, band-pass, or band-elimination network is desired, convert the element values by means of the frequency transformations of Part IV.

Additional Tables

For other synthesis applications the coefficients of the denominator polynomial and its zeros are needed. In fact, the coefficients are also needed even in the ladder networks of this paper for calculating the constant multiplier of the transfer function achieved by the network. In order to gather pertinent information in one place, tables of these values are also given.

**Butterworth Characteristic**

The Butterworth function \(1,2,3\) is used to approximate the squared magnitude of a transfer function. For the transfer impedance it is given by

\[
\left| Z_{221}(j\omega) \right|^2 = \frac{1}{1 + \omega^{2n}}
\]

This function gives an approximation to a low-pass filter characteristic; sketches of the Butterworth approximation for the first three values of \(n\) are shown in Fig. I-4. The Butterworth function is said to have a *maximally-flat* magnitude characteristic.

By use of Eq. 1 the complete transfer function is given as

\[
Z_{21}(s) = \frac{H}{B_n(s)}
\]

where \(H\) are constants which are to be chosen for each function. The following tables supply this information.

An on-the-paper example of the procedure given is shown in Fig. I-4. This procedure differs from the \(30\) db per octave filter approach but it is more general and applicable to a wider variety of functions.
where \( H \) is a constant multiplier. The polynomials \( B_n \) are called the Butterworth polynomials; their coefficients are given in Table I-2 and their zeros, all of which of course lie on the unit circle, are given in Table I-3.

The element values are given in Table I-1; the resulting networks realize the transfer function within a constant multiplier. To obtain the constant multiplier we let \( s = 0 \) in the network and in the transfer function.

**Example**

An example of the use of the tables to design a Butterworth filter is presented here.

We wish to design a low-pass filter that has a resistance termination at the output only. The cutoff frequency is \( \omega_c = 10,000 \) radians/sec and the output resistance is to be 750 ohms. At a frequency \( \omega = \omega_0 \), the magnitude response is to be down at least 30 dB. The input source is a cathode follower which approximates a true voltage source.

First we determine the value of \( n \).

\[
\frac{1}{1 + \omega^{2n}} \bigg|_{\omega = 3} = 10^{-3}
\]

\[
(1 + \omega^{2n}) \bigg|_{\omega = 3} = 10^5
\]

\[
3^n \cong 10^5
\]

\[
n = \log_2 \frac{5}{3} = 5.23
\]

The next larger integer \( n = 6 \) must be used.

Since no input resistance is required, the table for \( D = 0 \) is used, namely, Table I-1a. Since the input is a voltage source and \( n \) is even, the network form of Fig.1b (with \( B_n \) omitted) is applicable; that is, the unprimed element parameters are used.

Consulting the table yields the element values

\[
R_1 = 1, \quad L_4 = 1.553
\]

\[
C_1 = 0.2588, \quad C_5 = 1.759
\]

\[
L_5 = 0.7579, \quad L_6 = 1.553
\]

\[
C_3 = 1.202
\]

To obtain a load resistance of 750 ohms, we multiply \( R_1 \) and all \( L \)'s and divide all \( C \)'s by 750. To change the cutoff frequency to 10,000 rad/sec every \( L \) and \( C \) must be divided by this value.

The final values are therefore

\[
R = 750 \quad R_1 = 750 \quad L_d = \frac{RL_1}{\omega_c} = 1.16 \times 10^{-4}
\]

\[
C_a = \frac{1}{\omega_c R} = 3.45 \times 10^{-8} \quad C_v = \frac{L_2}{\omega_c} = 2.34 \times 10^{-7}
\]

\[
L_5 = \frac{RL_4}{\omega_c} = 5.68 \times 10^{-8} \quad L_6 = \frac{RL_5}{\omega_c} = 1.16 \times 10^{-7}
\]

\[
C_v = \frac{C_3}{\omega_c R} = 1.60 \times 10^{-7}
\]

and the network is shown in Fig. I-5.

At \( s = 0 \) the network becomes a pure resistance and therefore

\[
Z_{21} = \frac{H}{B_0(0)} = R = 750
\]

From Table I-2 \( B_n(0) = 1 \) so that the constant multiplier \( H \) is 750. The transfer voltage ratio \( E_2/E_1 \), since \( E_2 = 750 \ I_2 \), is given by

\[
\frac{E_2}{E_1} = \frac{1}{B_0(s)}
\]

**Acknowledgement:** The author expresses his thanks to the members of the Mathematics Section, Systems Analysis Department, Hughes Aircraft Company, who carried through the calculations for almost all the tables in this paper. This paper is based on Hughes Technical Memorandum 427 "Network Design by Use of Modern Syntheses Techniques and Tables."

**References**


**Table I. 2 Coefficients of Butterworth Polynomials \( B_n = s^n + a_{n-1}s^{n-1} + \ldots + a_2s^2 + a_1s + 1 \)**

<table>
<thead>
<tr>
<th>( n )</th>
<th>( a_1 )</th>
<th>( a_2 )</th>
<th>( a_3 )</th>
<th>( a_4 )</th>
<th>( a_5 )</th>
<th>( a_6 )</th>
<th>( a_7 )</th>
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<tr>
<td>1</td>
<td>1.4142136</td>
<td>2</td>
<td>2300000</td>
<td>2300000</td>
<td>3.2306860</td>
<td>3.2306860</td>
<td>3.2306860</td>
<td>3.2306860</td>
<td>3.2306860</td>
</tr>
<tr>
<td>4</td>
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<td>1</td>
<td>3.1415927</td>
<td>3.1415927</td>
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<td>5.3230686</td>
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<td>5.3230686</td>
<td>5.3230686</td>
</tr>
<tr>
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<td>1</td>
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<td>1.5707963</td>
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<td>3.1415927</td>
</tr>
<tr>
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<td>1</td>
<td>0.8641010</td>
<td>0.8641010</td>
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<td>1.5707963</td>
<td>1.5707963</td>
<td>1.5707963</td>
<td>1.5707963</td>
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<tr>
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<td>1</td>
<td>0.4067895</td>
<td>0.4067895</td>
<td>0.8641010</td>
<td>0.8641010</td>
<td>0.8641010</td>
<td>0.8641010</td>
<td>0.8641010</td>
</tr>
</tbody>
</table>

**Table I. 3 Zeros of Butterworth Polynomials \( B_n \)**

<table>
<thead>
<tr>
<th>( n = 1 )</th>
<th>( n = 2 )</th>
<th>( n = 3 )</th>
<th>( n = 4 )</th>
<th>( n = 5 )</th>
<th>( n = 6 )</th>
<th>( n = 7 )</th>
<th>( n = 8 )</th>
<th>( n = 9 )</th>
<th>( n = 10 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( -1.800000 )</td>
<td>( -0.701088 )</td>
<td>( -1.000000 )</td>
<td>( -0.3820834 )</td>
<td>( -1.000000 )</td>
<td>( -0.2588190 )</td>
<td>( -0.1950903 )</td>
<td>( -0.9009689 )</td>
<td>( -1.7175144 )</td>
<td>( -0.7528429 )</td>
</tr>
<tr>
<td>( -0.5000000 )</td>
<td>( -0.9238795 )</td>
<td>( -0.3090170 )</td>
<td>( -0.2225209 )</td>
<td>( -0.5555552 )</td>
<td>( -0.1736482 )</td>
<td>( -0.4939905 )</td>
<td>( -0.8910063 )</td>
<td>( -0.1564345 )</td>
<td>( -1.9587218 )</td>
</tr>
<tr>
<td>( -0.8640254 )</td>
<td>( -0.3820834 )</td>
<td>( -0.701088 )</td>
<td>( -0.9238795 )</td>
<td>( -0.2588190 )</td>
<td>( -0.1950903 )</td>
<td>( -0.9009689 )</td>
<td>( -0.7528429 )</td>
<td>( -0.7528429 )</td>
<td>( -0.7528429 )</td>
</tr>
</tbody>
</table>

---

Fig. I-5 Final network achieved for above example.

Fig. I-4 (Shown at Left) Sketches of the first three orders of the Butterworth approximation to the low-pass filter.
MEMO
FROM: The NJE Production Staff
TO: Electronics Purchasing Agents
SUBJECT: LOOK BEHIND THE PROMISE

Let's let our hair down, gents, and talk about delivery promises.
Most "catalog" equipment is available on short, accurate delivery schedules. For example, of the 881 power supplies in our catalog, all but 52 of them are available in from 1 to 20 days, and we rarely miff a delivery promise.

Custom equipment presents a much more complex problem. The most sincere delivery estimate is still an estimate. How can you evaluate the accuracy of a delivery promise before awarding a contract? We say — look behind it:
- How much of the job is under the vendor's control? — NJE, for example, manufactures over 85% of its product under its own roof. We build our own transformers, sheet metal components, have our own finishing, engraving, and welding facilities. We buy only standard catalog resistors, capacitors, and tubes.
- How much experience background does the vendor have at his command? — NJE, for example, has a file of over 4,000 custom designs to draw on for rapid revision to meet your specs.
- How "deep" is the organization technically? — NJE has the largest engineering staff in its field — 15 engineers, 7 mechanical designers, all with wide professional experience.
- Is the vendor big enough for the job? — NJE has reached a productive capacity of $200,000 worth of custom power supplies per month — it leads the field.

Look behind an NJE delivery promise — you'll find more than enthusiasm.

THIS Dyna-Scan Model 1000 Picture and Pattern Video Generator is a self-contained flying spot scanner. It produces a composite video and sync signal that operates any standard black and white or color TV receiver on any vhf channel. By placing a slide film transparency in front of the scanning tube, any picture or pattern is reproduced with high definition on the TV set. It can be used with a single monitor or any number of standard TV receivers, or can be fed into a master antenna system. Maximum capability is well in excess of 400 lines. Coupling to the receiver is made by attaching the 6 ft output cable of the Dyna-Scan to the antenna terminals.

The manufacturer of this pattern generator is the B & K Manufacturing Co., 3731 N. Southport Ave., Chicago 13, Ill. Any of the standard test patterns can be produced as shown. Also, any other pattern can be drawn and reproduced at will. All color TV receiver static and dynamic convergence adjustments can be made readily with stable white dot and white line patterns. Laboratory testing is expedited by the use of this instrument.

The Dyna-Scan can also be used as a closed circuit TV system with unlimited range of subject material for merchandising, advertising and industrial use. Pictorial or graphic material can be transmitted and reproduced in stores, schools, plants, offices, hotels, and institutions. It may also be used as a paging video system to project typed or written messages, and as a square-wave generator for video amplifier trouble shooting. Rf modulated carrier output of any VHF TV channel frequency is continuously variable from
Portable Video Generator

50,000 µv to minimum level for testing fringe area TV receiver sensitivity. Built-in synchronized bars make the unit self-calibrating and ensure vertical and horizontal linearity.

Tube complement is: 5BKPV-1 5 in. flying spot scanner tube, 931A photo multiplier, 12AT7 rf oscillator and modulator, 6CM7 vertical oscillator and amplifier, 6C4 vertical bar generator, 6CG7 horizontal oscillator, 6BQ6GT horizontal amplifier, 6AX4/6W4 damper, 1X2B high voltage rectifier. Rated at 150 w, the unit operates on 60 cy, 115 v. It weighs 28 lbs and measures 16.5 x 10.4 x 9.5 in. A convenient carrying handle is provided.

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Automatic Measurement of Damped Oscillations

INSTANTANEOUS measurement of damping characteristics of aircraft structures, certain electronic circuits and the like is a feature of the Dampometer, a Swedish instrument combining several unique design features. Because an oscilloscope is capable of producing an instantaneous trace of the damped oscillation, it is the first unit of the instrument into which information is fed. After proper conversion of the trace, the information is routed to a counting unit that picks off the quantities and presents the information on decade counter tubes.

First problem in the design of the device was to convert the oscilloscope trace of a damped oscillation into a form that may be “read.” Designer of the instrument, Carl Olsson of Sweden, converted the damped oscillation into a rotating vector appearing as a rotating spot on the oscilloscope screen. Velocity of rotation of the vector is directly proportional to the frequency of the oscillation; length of the radius vector represents amplitude.

Rate of rotation and vector length are transformed into a series of light pulses, then into voltage pulses. A radially-slotted disk placed over the oscilloscope screen breaks the rotating spot into a series of light pulses. These light pulses are picked up by a multiplier phototube, converted by proper circuitry into voltage pulses to be shaped, and counted. Pulses are counted by...
a damping counter consisting of the necessary trigger tubes and electrostatic, high-vacuum decade counter tubes.

Frequency of oscillation is measured by comparison with the frequency of an R-C oscillator. A frequency counter similar to the damping counter counts the number of cycles of the R-C oscillator between two selected light pulses.

Results are presented on the counter tubes on the panel of the instrument. One group records logarithmic decrement of damping, the other records frequency. Applications of the unit include wind tunnel installations for aerodynamic testing, and solution of problems in acoustics and electronic circuits.

Typical damped oscillations and their representation as a logarithmic spiral.

Radially-slotted disk placed over the oscilloscope screen breaks up the rotating vector into light pulses.
Three-Dimensional Cam Circuit

Max Fogiel  
Ford Instrument Co.  
Long Island City, N.Y.

SOME computers require a three-dimensional cam when it is necessary to obtain an output $Z$ which is a function of two variables $x, y$ such as $Z = f(x, y)$.

An electronic circuit, described in this article, will develop an output which is a function of two variable inputs and effectively replaces the mechanical three-dimensional cam.

The circuit is based on the principle that a linear potentiometer may, by connecting proper tap resistors to it, be converted to one which will have an output voltage proportional to a nonlinear function. For a given arrangement of tap resistors and potentiometers, the output will be proportional to a given function of shaft position $x$. To change the characteristics of the function it is necessary to change the tap resistors.

Consequently, where the output $Z$ is a function of both $x$ and $y$, the characteristics of function $x$ depend upon $y$. Therefore it is necessary to vary the values of the tap resistors in accordance with the demands arising out of the variations in $y$.

Variation of tap resistors with $y$ is accomplished by rotating a number of potentiometers by the quantity $y$, Fig. 1. One potentiometer is provided for each tap resistor.

In determining the values of the resistances, the first step is to draw a curve of output $Z$ versus shaft rotation of the $x$-axis potentiometer for a fixed value of $x$.

To find the location of the tap points, a series of straight lines are superimposed on the curve closely approximating the curve. Each intersection of the lines, Fig. 2, is a tap point. Accuracy, of course, is increased by drawing more lines which result in more taps.

Resistance between taps is proportional to the distances $a, b, c$, and $d$ on the $x$-axis. For example, $R_a : a$, $R_b : b$, etc. Potentiometers $x$ and $y$ may be represented by the circuit of Fig. 3a. To calculate actual values, it is necessary to work from the equivalent circuit, Fig. 3b. Values for the equivalent resistances may be calculated when the load resistance, $R_L$, the reference voltage and the output voltage at any tap of the circuit diagram.  

Fig. 1. Simplified circuit diagram of an electrical three-dimensional cam.  

Fig. 2. Shaft rotation $x$ versus output $Z$. This curve represents a cross-section of a three-dimensional cam at a point $y$.  

ELECTRONIC DESIGN • September 15, 1956
why companies find it
GOOD BUSINESS
to specify panel instruments
by Simpson...

Fig. 3. Heart of the three-dimensional cam circuit is
the tapped potentiometer (a). Its equivalent circuit,
(b), is used to calculate resistance values between taps.

A dual axis potentiometer are known. For example, the
equivalent resistance \( R_{37} \) determined by the relation:

\[
R_{37} = \frac{1}{2} \left[ \left( \frac{R_3}{d} \right) + \sqrt{\left( \frac{R_3}{d} \right)^2 + 4 \frac{R_1}{R_4}} \right] - R_4
\]

where

\[
R_i = \frac{R_i}{d} \left( \frac{R_i}{d} + R_i \right)
\]

and is the total equivalent resistance for the voltage
reference supply.

Having evaluated \( R_4, R_5 \) and \( R_37 \), is it possible to
calculate the \( R_3 \), the value of the \( y \)-axis potentiometer.
It is possible to insert either potentiometers having
the required functional windings, or tapping linear
potentiometers and connecting the required parallel
resistors across these tap points. The magnitude of
these resistors is readily computed from the condition
that the equivalent parallel combination must
equal the corresponding value of the preceding tap
resistors. These resistors may be of the fixed type,
for variable resistors may be set to the correct value.

Electrical output \( Z \) may be converted to mechanical
form by connecting the output to the signal leg of
a nulling or summing network, and the feedback leg
of this network to a linear potentiometer whose
applied voltage is oppositely directed to that of \( x \)-axis
potentiometer. The servo motor will drive and position
a potentiometer so that the magnitudes of the
currents in both legs of the network are equal. In
this manner the shaft position of the potentiometer
will be proportional to the quantity \( Z \). With the output
\( Z \) thus established in the form of a mechanical
quantity, the circuit of Fig. 1 is a direct and effective
electrical substitute for three-dimensional mechanical

tum.
Patents Are Valuable

Matthew Russo
685 Alabama Ave., Brooklyn 7, N.Y.

This article is in response to one by Mr. Raymond C. Miles, "What Good Are Patents", which appeared in the May 15th issue of ELECTRONIC DESIGN. The present article, "Patents Are Valuable," is intended to refute some of the contentions raised by Mr. Miles, and to present, according to the author, "a more thorough and complete picture of the patent system in general."

Mr. Russo, a patent consultant, has been active in the field of patent sales promotion.

INVENTIONS have been responsible for raising man's standard of living. As an encouragement to invention, there has developed a concept of property rights known as the "patent system." Basically, the patent system was designed to assure the development of new things which would react favorably upon the economy. It is a means of promoting the progress of science and useful art. "Invention" involves the bringing forth of some new idea which, when reduced to practical usage, will satisfy some want or desire, either latent or previously experienced. It is not limited to developments in the physical sciences or industry, but applies to all creative intellectual endeavors.

Classifications of Inventions

The importance of an invention depends upon the end result. Sometimes the result satisfies an intense want of many people; yet, sometimes it is of little usefulness to society, satisfying the wants or needs of the originator or inventor only. Based on the importance of the end result, inventions may be classified as: Basic or extensive inventions; developmental or intensive inventions, and minor inventions.

Basic Inventions. Revolutionary results flow from basic or extensive invention. Inventions of printing, telecommunications, explosives, the aeroplane, and the steam boat are examples. When such great developments are first presented to the public, they are usually deprecated and under-valued; the inventor is often considered a dreamer or a dangerous person to be suspected or shunned. Before full commercial advantage can be taken of the invention, inertia and apathy must be overcome.

Developmental Inventions. Original inventions are so basic and extensive in character as to require much further development and improvement. Most inventions today are of the developmental or intensive type which add to or improve existing inventions.

Minor inventions result in the production of gadgets, of which there are many. Socially, such inventions are of distinctly minor importance, though they are of great consequence to the inventor, particularly during the first rush of enthusiasm that besets him upon becoming an inventor.

From the standpoint of complexity there seem to be two extremes in the scale of invention. The simple "gadget" type requires relatively little scientific knowledge for its conception and limited capital for its exploitation; whereas, the more complicated invention requires extensive scientific knowledge and considerable capital to bring it to the point of even a successful commercial demonstration.

Motivating Factors

The prospect of income or profits from the marketing of inventions motivates inventors. An influx of inventive talent is attracted to a particular field when developments in the field offer good prospect of financial reward. When patent laws were first drawn, inventions and discovery were almost exclusively the product of the efforts of individuals working alone. Today invention and discovery are largely the work of research laboratories. It is estimated that 60 per cent of patents now go to corporations and only 40 per cent to individuals. As a result, the independent inventor...
is continually finding it more difficult to defend and market his own inventions. In this respect, Mr. Miles stated that patents are seldom considered a potential avenue to personal wealth and that the large proportion of patents are issued to individuals working for a salary. I would like to answer this contention by the following observations:

Except for a few minor areas of business activity, the industrial and technological economy of today bears little resemblance to that of yesterday. The relatively simple, easily understood and inexpensive inventions have given way to highly complex inventions that require extensive scientific training to understand and substantial experimentation and capital to perfect and develop. The “garage” inventor has given way, to a marked extent, to the coordinated group activity of the research laboratory. Therefore the fault does not lie with the patent system, but with the gradual evolution of our economy.

The contention that a salaried design engineer who invents something receives only $1 to $100 for the assignment of his invention, is not quite accurate and requires examination. Such an individual, after all, is being paid a salary either to do research or invent; and if incidental to his employment, he invents something, it is only fair and equitable that his invention be considered a natural consequence of his employment. Therefore, any extra consideration from his employer for this effort should be considered fair. Furthermore, it is to be expected that an individual who invents many devices which his firm patents, will in time be promoted to a position of greater responsibility, resulting in a higher salary.

Inventors must also consider the market investment and business hazards involved in marketing any invention—whether a new product, a new machine, or a substantial improvement. If an invention is not profitable, the fault by no means lies with the patent system; although a prerequisite to obtaining a patent is that the device be new and useful, there is no requirement that the particular device be commercially practicable. Many individual inventors waste time and money filing patent applications that should never have been filed, and in trying to exploit unprofitable inventions. This happens because of a lack of technical background or business sense. An inventor who undertakes to exploit his own invention often lacks necessary managerial ability. This is attested by the relatively high salaries capable business managers are able to command.

Notwithstanding unfortunate experiences of many, the individual inventor working in a field in which he has technical competence and directing his efforts towards the current problems in the field, performs a vital and important function. The patent system is designed to encourage this type of inventor. There are many aids of which the independent inventor should take advantage before filing a patent application. Once a patent is granted there is still no assurance that the invention will be a financial success. The Small Business

---

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Check the table below for the models you need. Order single units for development work, or thousands for production runs. Prices from $42.00 (even more favorable depending on quantity).


<table>
<thead>
<tr>
<th>No-load speed—rpm</th>
<th>27</th>
<th>54</th>
<th>162</th>
<th>333</th>
<th>1620</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated torque—in. oz.</td>
<td>30</td>
<td>15</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Max torque—in. oz.</td>
<td>85</td>
<td>43</td>
<td>19</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>rpm for max power</td>
<td>15</td>
<td>31</td>
<td>92</td>
<td>190</td>
<td>900</td>
</tr>
</tbody>
</table>

MONOPOLY OF A PATENT

A patent is the reward for invention or discovery of something new, something added to the sum total of human knowledge, something which the inventor might withhold from his fellow man. By granting a patent, the Government protects the inventor for a limited time. A patent awards a temporary monopoly to the inventor—the right to exclude others from making, using, or selling the invention (as claimed) until the patent expires. Mr. Miles stated that a patent only represents the exclusive right to the use of an invention, but neglected to add that it also gives the inventor the right to preclude others from making or selling the patented item. This is of extreme importance. If a competitor not only knows of an invention, but also of an intent by the inventor to patent it, this normally discourages infringement.

In this country, the right to obtain a patent is an absolute right for the benefit of the inventor. This is not so in many foreign countries where the granting of the patent right is not quite so absolute and is surrounded by many conditions. As a result, it is my sincere opinion that this country provides, by its unconditional patent monopoly, the greatest stimulus to invention that exists anywhere in the world.

THE MEANING OF A CLAIM

There is probably no class of writing requiring more skill or perception than the drafting of patent claims and certainly none more intriguing. Within a few lines must be condensed the substance contained in many lines and pages of descriptive text. But patent claims must do considerably more than merely abridge the description of the invention appearing in the specification of the patent. The real purpose of the claim is to fix the extent of the monopoly granted by the patent, i.e., to define precisely what is the thing which exclusively belongs to the inventor. The specification merely describes the invention; but one must look to the claims to determine what actually constitutes the invention protected by the patent. The claims must not only be descriptive and inclusive (metes and bounds of the invention) but they must also be distinctive (e.g., patentably differentiated by prior devices or art).

Mr. Miles has made the contention that few patents pass the test for really top-notch protection, since either the claims are weak or the invention is not fundamental. He also contends the possibility of direct income from patents is not attractive to electronic
A study of the record—substantiated by hearings on the American patent system before the 84th Congress at which representatives of 500 of the largest corporations discussed their views on the merits of the patent system—leaves the impression that Mr. Miles contention is not quite correct. These representatives discussed the potential worth of patents to their respective corporations. It was clearly indicated that patents still afford a great protection from competition and where the patents are for labor-saving devices, a great improvement in operating efficiency of mass production systems. Many of these firms alleged that the success of their corporations was based mainly on the strength of their patents. Manufacturers in various industries cited specific examples of how patents, both of the fundamental or improvement type, provided the inspiration that resulted in the vast progress of their firms.

Another interesting observation brought out by some of the corporate representatives was the fact that engineers who have an understanding of patents are provided with a powerful engineering tool. This is because patents are the source material of past engineering development and indicative of present engineering trends. Patents available for reference at the U.S. Patent Office in Washington, D.C., afford an engineer a review of a century and a half of engineering progress in any field. From a company standpoint, the engineer who understands patents is a valuable man because he is in a position to steer the company clear of the staked-out areas of the patented inventions of others. If the engineer is familiar with the prior art and his competitors' patents, he will be able to protect his company from possible liability arising out of infringement. It is, therefore, a good idea for the engineer to become familiar with the patents; the earlier the better, because he will find that patent knowledge is predominantly gained by experience and not from textbooks.

The patent system was not intended to afford protection to private parties against the copying by others of new products which involve only improvements normally to be expected in the orderly course of product development. The primary purpose of the patent system is to promote the progress of science and the useful arts. This purpose is achieved by acquainting the public with advances requiring more than ordinary ingenuity and by keeping alive the disclosures others have made in the past. The reward which the inventor hopes for, and which furnishes him with an incentive to invent and disclose his inventions, is not directly provided for by the patent law. It merely establishes conditions favorable to exclusive exploitation of an invention by its owner for a limited period of time. The reward must be earned by commercial exploitation of the invention, or obtained by sale of rights to someone who believes he can make profits by virtue of possession of such rights.

Hearings, Amer. Patent System ptl 84 Cong. p925

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**a new ceramic capacitor**

**designed specifically for printed wiring application**

These rugged, high performance miniature units will meet your requirements in most coupling, by-pass and other general applications. Bulky lead terminals and outside covering are completely eliminated. The dense, non-porous dielectric material withstands the most severe humidity conditions.

---

**WEJCAPs**

- Design problems for automatic placement heads are greatly simplified by the tapered edges and flat sides of the units.
- Strong mechanical mount is achieved by the solder connection of the silver electrode to the copper circuit.
- "Wejcap" Capacitors represent the lowest possible unit cost for comparable quality in capacitor components and offer perfect adaptability to low-cost high volume production methods.
- Developed by the producers of famous General Electric "Thru-Con" Print Wire Boards these units are the result of extensive development effort in ceramic dielectric material by General Electric scientists.

For full information write to

GE—SPECIALTY ELECTRONIC COMPONENTS DEPARTMENT
W. GENEEKE STREET, AUBURN, NEW YORK

CIRCLE 27 ON READER-SERVICE CARD FOR MORE INFORMATION
CERAMICS find wide application in electron-tube design, and the developments in this area should be of interest to designers working on other electronic design activities as well. The ceramics field is much broader than is generally realized. The American Ceramic Society divides the field into eight parts—abrasives; art ware; cements, lime, and plaster; enamels; glass; structural clay products; refractories; and white ware.

Glasses

Of these, glass is the most used in electronics. One of its main uses has been for envelopes in the vacuum tube industry. It has excellent working characteristics, as it can be shaped or molded into almost any form. Also, there are so many different glass compositions, each with its own characteristics and properties, that a glass can be found suitable for almost any purpose. The principle limitations of glass are its fragile nature and its low-temperature softening point which limits the operating temperature of the tube.

Glasses vary in their expansion characteristics as do metals; hence, proper matching to metals in glass-to-metal seals is very important. In general, glasses have a higher rate of expansion at higher temperatures. Soft glasses have higher expansion characteristics than hard glasses.

Glass bulbs vary in size from those required for subminiature receiving tubes to those required for the large TV tubes and in composition from soft glass to hard glass. The trend in design is away from large bulky bulbs and toward smaller bulbs with straight sides. Soft glass has already been replaced by hard glass in most power tubes to accomplish higher temperature bake-out operation and improved electrical properties.

Electrical Conduction Through Glass

In most tubes it is necessary to provide a method of conducting electrical current to the element inside the tube while maintaining a good vacuum at operating temperatures to 300 C. Metal is a good conductor; thus, the method employed is glass-to-metal seals, with metal leads protruding through the glass.

When metal leads are brought into the glass, an expansion mismatch can be tolerated if the leads are small enough. In all cases the glass and metal must be brought to at least red heat so that the glass can be softened sufficiently to wet the metal. For mass production of seals, the matching of glass to glass is most important.

Housekeeper Seal

Since in practice it is sometimes difficult or impossible to match glass to metal, various adaptations of what is commonly called the "housekeeper seal" are made. Thin sections of some metals yield to expansion of the glass because of their ductility and low yield point. When thin sections of soft metals are bonded to glass, the matching expansions are unnecessary. A common "housekeeper seal" method is to bead a thin copper section with glass and then seal to tubing of a matching glass. The thin section of the copper conforms to the expansion of the glass without overstressing the glass.

Pre-Glassing

Improper adherence of glass to metal can be overcome by pre-glassing the metal. An example of this is evident in color TV face panels. One type of seal uses porcelain enamel (a glass) applied to the metal, with subsequent glass face-plate sealing to the porcelain enamel. Another similar example is the pre-glassing of Kovar so it will not become over-oxidized during further processing.

When a glass and a metal must be sealed together and they have different expansions, graded seals can be used. A glass that matches the metal will be sealed to the desired glass in steps. The steps are usually different in expansion by a maximum of 7 points in the coefficient of expansion. An example is shown in Table I where a No. 7720 glass bulb with a coefficient of 36 is matched to Kovar which has a coefficient of 50. Two steps are used in-between as indicated.

<table>
<thead>
<tr>
<th>Table I</th>
<th>Step-Seal Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal &amp; Expansion Coef.</td>
<td>Step Glasses</td>
</tr>
<tr>
<td>#1</td>
<td>#2</td>
</tr>
<tr>
<td>Kovar</td>
<td>#7052</td>
</tr>
</tbody>
</table>

Table II provide a comparison of the mechanical and physical properties of common ceramics used in electronic components. The values are based on the bulk materials and may vary with the specific application.

<table>
<thead>
<tr>
<th>Table II</th>
<th>Ceramic Trade Name</th>
<th>Tensile Strength lbs/sq in.</th>
<th>Impact Resistance ft-lbs</th>
<th>Hardness Mohs's Scale</th>
<th>Safe Operating Temperature Deg C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alumina</td>
<td>18,000 to 25,000</td>
<td>6.5 to 7.5</td>
<td>9</td>
<td>1400</td>
<td></td>
</tr>
<tr>
<td>Zircon</td>
<td>10,000 to 12,000</td>
<td>5.0</td>
<td>8</td>
<td>1600</td>
<td></td>
</tr>
<tr>
<td>Steatite</td>
<td>10,000</td>
<td>4.0</td>
<td>7.5</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Forsterite</td>
<td>10,000</td>
<td>4.0</td>
<td>7.5</td>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>

* Based on a paper "New Uses of Ceramics in the Electronic Tube Industry" presented by Mr. Huffcut at a regional AIEE Meeting, April 17, 1956, in Fort Wayne, Ind.
Metallizing

Another glass-to-metal seal is accomplished by metallizing the glass. This can be done by applying the metal in the form of a suspension in oil. The metals diffuse in the glass at high temperatures in an oxidizing atmosphere, but with sufficient metal remaining on the surface to permit bonding to solder. Use of glass flux assists in the bonding. They are then electroplated with copper and ready for further soldering. These seals cannot be operated at high temperatures.

Miscellaneous Methods

Another method of applying metal to glass is by spraying of hot metal on the glass or ceramics at 200-400°C, using a schoop metallizing gun.

A small amount of metal can also be applied by transferring metal to a rotary steel brush, from which it is rubbed onto the ceramic or glass.

Solder-glass sealing is helpful where there is danger that heat might damage components of the tube. Parts currently being sealed with solder glass range in size from hearing-aid components to color TV panel-to-panel seals. Solder glasses with softening points in the range of 400°C are available for such uses. These glasses will even seal to mica, other glasses, and aluminum.

Whiteware Ceramics

The need for still higher operating temperatures, ease of higher frequencies and higher power levels pointed to the use of whiteware bodies, commonly called “ceramics.” The wide variety of ceramics with varying properties offer broad possibilities for application. Most commonly used ceramics are given in Table II.

High-purity alumina ceramic parts are valuable for their high safe operating temperature, low loss factor, high strength and non-gassy condition. They are readily outgassed at high bakeout temperatures, and they assure harder and more permanent vacuums. Surface finishes can vary from an unglazed as-fired condition to a glazed, ground and lapped condition. Glazes can be supplied in white or colors with a smooth surface that can readily be wiped clean. Tolerances of parts are becoming closer, especially by grinding. The high purities available have reduced the doubt of probable contamination.

Methods of forming ceramics have also advanced. For instance: extrusion of tubing with two holes can be made so small that the holes can barely be seen with the naked eye. Pieces can be threaded internally or externally to fit standard screw sizes. Blind holes can be tapped or left plain. Grinding methods have been improved to allow almost any shape to be made. Alumina can be readily metallized and, when brazed to metal, results in a high-strength vacuum-type bond.

Fabrication of alumina ceramics is relatively simple, allowing a size range from a fraction of an inch in diameter and lengths to 18 in. For use as windows, thicknesses down to 0.010 in. have been produced.

Here’s One Reason Why You Should Know About AMP Terminals

AMP meets the requirements of modern business machine and computer manufacturers for reliable, miniature wire terminations which can be installed at high speed. As the complexity of circuits and number of terminations increases, so must the dependability, efficiency and ease of application increase. AMP is constantly working to develop better and better solderless wiring to meet these requirements.

Have your name put on the AMP mailing list to receive valuable information about these developments.

Examples of the advanced thinking that is part of all AMP solderless wiring devices:

AMP TAPER PINS (1) and TAPER TAB RECEPTACLES (2) designed to save space and weight in electronic circuitry. AMP Pre-Insulated Diamond Grip Terminals (3) eliminate tape and spaghetti and are used extensively by every major aircraft producer. AMPLIVAR Splices (4) speed production for mass produced motor windings, transformers, etc., using enamel, poly-vinyl acetal or similarly coated wire. AMP FASTON Terminals (5) for all kinds of electrical appliances have revolutionized harness sub-assembly methods.
We can handle ANY requirements you have

The group of magnets illustrated above are indicative of the great scope of Arnold production in this field. We can supply these permanent magnets in any size or shape you may need; in weights ranging from a few ounces to 75 pounds or more; and with die-cast or sand-cast aluminum jackets, Celastic covers, etc., as required. Complete assemblies may be supplied with Permnendur, steel or aluminum bases, inserts and keepers as specified—magnetized and stabilized as desired. • Let us handle your magnetron, traveling wave tube and wave guide permanent magnet requirements, or any other magnetic material specification you may have.

Commercial tolerance is ±0.001 in, and 0.0001 in can be achieved by grinding (for an additional cost). The parts can be made dense or porous, as desired; the latter is desirable in some cases to permit efficient outgassing.

The Zircon ceramics have a greater thermal shock resistance and are softer than Alumina. The softness allows grinding to a given size at lower cost. Electrical properties are excellent at relatively low operating temperatures.

The steatites are being constantly improved and are relatively low in cost. They were originally chosen for their thermal shock resistance and low-loss properties. As in the Aluminas, the parts can be made in most any shape desired.

Selection, Forming, & Sealing

Any supplier of whiteware ceramic parts will gladly supply property charts for the choice of a proper type to use for a given application, depending on the electrical and physical requirements.

One of the newer methods of forming parts is called isostatic pressing. The pressure is applied simultaneously in all three directions so the result is a more uniform shrinkage from drying and firing.

The ceramic-to-metal sealing processes have advanced in simplicity in a relatively short period of time. The original and standard process is the 3-step moly-manganese process. It consists of three steps: 1. applying moly-manganese mixture and firing in a reducing atmosphere; 2. applying nickel or copper and firing in a reducing atmosphere; and 3. brazing to the metal part. The advantages of this process are a strong bond, good reproducibility and excellent dimensional control. The disadvantages are necessity for three firings, and the fact that firing in hydrogen discolors the ceramics and may impair the electrical properties.

A simpler process for metallizing involves application of titanium hydride to the ceramic parts. The parts are then assembled with a silver-solder wire contact between the parts to be joined. One firing in vacuum or inert atmosphere at a temperature just above the melting point of the solder results in a satisfactory seal.

Another new method uses a titanium cored silver solder in a preformed ring. This ring, like a washer, is placed between the parts in the assembly. One firing in vacuum or inert gas up to 950 C seals the parts together. The primary disadvantage is less dimensional control.

Special Applications

Ceramic Printed Circuits

Printed circuits are relatively new, using silver for the conductor on high dielectric ceramic plates. The printing can be done in various ways, including the silk screen method. Glass now adapts itself for printed circuit base material. Photoform and Fotoceram are photosensitive glasses that can be machined with photographic precision for ease in the attachment.
Cermets

Cermets, which are formed by mixtures of metals and metal-oxide powders processed into solids by powder metallurgy methods, find use for cathodes where the metal oxide combinations exhibit thermionic emission. These cermets can be made in almost any desired shape by pressing or extruding and can be held to normal tolerances of 0.005 in. For closer tolerances, grinding methods can be used. The most recent development in shaping is hot pressing. By pressing when the material is fluid, a more homogeneous mass is obtained with resultant higher density and purity.

Ferrites

Ferromagnetic ferrites are compounds of various metallic oxides. These are ceramic materials with crystalline structures that have unusual electrical properties such as high volume resistivity and high permeability. To be ferroelectric a material must be inherently polarizable, and the direction of its polarization must be controllable by a relatively weak applied field. Any electrically induced change in polarization will result in a mechanical deformation of the crystal. This property is utilized in devices known as transducers which convert mechanical energy to electrical energy and vice versa.

Ultrasonic Resonators

Electrostrictive resonators of barium titanate are used extensively in the ultrasonic field that is developing quite rapidly. Newer applications are in the cleaning of parts and for machining hard materials. The machining can have controlled depth, and hole shapes are unlimited in possibilities.

Thermists

Thermists are solid-like semiconductors whose electrical resistance varies greatly with temperature. Thermists have high negative temperature coefficients; i.e., when cold, their resistance is high but drops rapidly as temperature rises. Such characteristics provide a unique and versatile circuit element or control device which can be adapted for many applications including temperature control, flow meters, voltage regulators, switching devices, etc.

Varistors

Varistors have the property of a changing resistance when the applied voltage is varied. They have high resistance to negative voltages and extremely low resistances to positive voltages. Some of the materials exhibiting this property are silicon carbide, lead sulfide and selenium, and copper oxide.
Featuring an unusually wide frequency range, 0.2 cps to 20 kc, this Variphase Oscillator has two independent signal outputs of the same frequency but with controllable relative phase.

This instrument is manufactured by Dubrow Development Co., 235 Penn St., Burlington, N. J., as Model 445-A and is presently available for commercial use as well as for governmental requirements.

The amplitude of each output signal can be varied independently from 0 to 10 v. A phase-difference dial controls the phase angle between the two signals. This can be varied from 0 to 360 deg, with an accuracy of ±2 deg.

Applications include determination of phase shift in an amplifier or network under test, rapid measurements of total harmonic distortion, and time measurements.

For special applications two or three phase-difference dials can be provided, with a corresponding increased number of output signals.

Basic to the Variphase Oscillator is a regulated power supply and a stable R-C oscillator.
Oscillator

The circuit also incorporates a phase inverting amplifier, phase network driving amplifiers, a phase shifting network, cathode followers and output amplifiers. Printed circuits and miniature components are employed which result in a small packaged unit.

For additional information on this product, turn to the Reader’s Service Card and circle 391.
Whisker Loader

Transistors are a "natural" for computers because of their small size, long life, and lower power needs than vacuum tubes. While most transistors used today are of the junction type, some applications require the point-contact type. In this type, the desired trace element is introduced into the germanium "heart" by passing a large pulse of current through the pointed wire—which contains the desired trace element and which is in contact with the germanium. The result: heat causes the element to penetrate or diffuse into the germanium. An important problem in the development of a manufacturing process for this type of transistor was to determine—one at a time—the influence on the diffusion process of each of the various factors involved. Jim Hanson, of our Poughkeepsie Research Laboratory, tackled this problem and came up with some of the answers by using what he calls the Whisker Loader. This precision instrument which he developed makes it possible to place the point of a five one-thousandths inch diameter wire upon the germanium surface; momentarily press the point against the surface with an accurately determined force of several grams; remove the wire and measure and inspect the area of contact between the wire and the germanium with a microscope (as small as one hundred-millionth of a square inch); and then replace the wire on the germanium, in the same position it first occupied, for electrical pulse forming. Our knowledge and understanding of pulse-forming techniques have been greatly increased by the use of this instrument.

A full report that clearly details test procedures, test results and other pertinent data is available in IBM Bulletin No. 300. Write for your copy.

Liquid Memory

Put a small amount of liquid such as glycerine in a d-c magnetic field, apply radio frequency pulses, and one can obtain radio frequency "echoes" of the applied pulses! This is the essence of the spin-echo effect which has been used by IBM scientists to store information in liquids containing hydrogen nuclei. By proper combinations of r-f pulses, hundreds of echoes in "mirror order" or in "normal order" can be obtained. Referring to schematic below, when a liquid containing hydrogen—such as water or glycerine—is put into the test tube and pulses of r-f current are applied to coil T, pulses will be produced across the terminals of coil R as shown. The pulses \( e_1, e_2, \) and \( e_3 \) are found only if pulses \( f_1, f_2, \) and \( f_3 \) have been applied and hence are called "echoes."

The effect may be understood in terms of the magnetic moments and angular momenta or spins of the hydrogen nuclei. In the d-c magnetic field, the nuclear moments are aligned so that the net moment throughout the sample is parallel to the field. A weak r-f pulse tilts the net moment away from the d-c field, about which it then precesses. But, due to inhomogeneities in the field, moments in different parts of the sample process at slightly different rates . . . get out of phase with one another, and hence cannot be detected. The strong r-f pulse rotates all of the moments so that those which were farthest ahead in phase become farthest behind, and conversely. Subsequent precession brings the moments back into phase, giving rise to the echo signal.

A research group at the IBM Watson Laboratory in New York City, headed by Robert M. Walker, has investigated this effect and succeeded in storing a thousand "bits" of information in a thimbleful of liquid. Some day this form of memory may be an important component of a computing machine.

This method of storage based upon the principles of free nuclear induction is more fully described in IBM Bulletin No. 301.

To learn more about career opportunities available at IBM, write, describing your background, to: W. M. Hoyt, IBM, Room 909, 590 Madison Avenue, New York 22, N. Y.

HIGH power in miniature size and single hole chassis mounting make this new wire wound resistor significantly interesting. More rapid heat dissipation is afforded by a finned surface on the die cast aluminum housing, together with the location of the resistor hot spot in close proximity with the chassis.

Manufactured by Dale Products, Inc., Box 136, Columbus, Nebr., DALOHM PH-25 resistors are available in values from 0.1 to 15,000 ohms, and with tolerances from 0.5 to 5 per cent. Power rating is 25 w at 25 C ambient, derated to 0 w at 265 C when mounted on a 12 x 12 x 0.056 in. panel. The maximum safe operating temperature is 265 C. Temperature coefficient of the element wire is 0.00002/deg C. Voltage breakdown is 1000 v dc rated, as determined by hi-pot test. Insulation resistance is 20,000 megohms minimum at 25 C ambient temperature.

Fully protected for shock and vibration, and weighing only 15 gm, these resistors are silicon sealed against environmental effects of moisture and salt spray. Both lug-type terminal leads protrude from the resistor on the same side of the chassis. The resistor meets applicable photograph of MIL-R-18546-A (Ships) and MIL-R 26-B.

For further information on these new resistors turn to Reader's Service Card and circle 392
Miniature 25-Watt Power Resistor

MOUNTED ON 12 X 12 X 0.059 PANEL

Derating Curve

Ambient Temp. (°C)

No manufacturer can show a matching record of precision engineering achievement in this most exacting department...or better our record of PROVED service in the field. Reeves was one of the first to achieve quantity production to high precision standards of the HIG-5 Gyro...the "work-horse" of the gyro field.

Now Reeves has stepped up volume on the new HIG-4 to meet both military and commercial needs...with these exceptional features:

**EXTREMELY LOW DRIFT:** Trimmed drift rate less than 3° per hour.

**FULLY FLOATED:** Will withstand over 100 G's shock

**MASS UNBALANCE:** Less than 0.5 dyne-cm.

**WIDE RANGE:** Signal generator sensitivity and torque generator sensitivity.

**EXTREMELY COMPACT:** Only 2" dia. x 3" long.

Reeves is now ready to meet your requirements with a full range of single-degree-of-freedom, viscous damped rate and integrating gyro and accelerometers, volume produced to exceptional standards in one of the finest gyro facilities in the world. Outline your needs for our recommendations.
Probes for Multimeters

for h-f test leakage

Robert G. Middleton
Consultant, Futuramic Co.

Volts-Ohm-Milliammeters are the most popular type of electrical testers in use at present. Many more VOMs have been sold than any other test instrument. In spite of its widespread usage, auxiliary devices and accessories to increase the fields of usefulness of the VOM have been somewhat neglected in the past. Today, however, such accessories have made an appearance, and are rapidly gaining general attention. Several probe accessories are discussed in this article.

Signal Tracing Probe

The signal-tracing probe illustrated in Fig. 1 is typical of the new accessory devices designed for use with any VOM. The probe is basically a traveling detector, which rectifies and filters rf, if, af, and lf.

Fig. 1. Operator tests signal level in horizontal-output stage by holding probe tip against glass wall of tube. The probe (inset) converts any 20,000 ohms-per volt meter into a signal tracer.

Better Performance - on every electrical and electronic application because...from ingot to final inspection, every test known to science safeguards the quality of Wilbur B. Driver Precision Alloys. These tests assure performance as specified! Why not consult a Wilbur B. Driver sales engineer for recommendations on precision alloys for your applications.

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For Over Thirty-five Years Manufacturers of Dependable Electrical, Electronic, Chemical and Mechanical Alloys CIRCLE 35 ON READER-SERVICE CARD FOR MORE INFORMATION
voltage for indication on the dc volts scale of the VOM. The probe is plugged into the meter in place of the conventional test leads, and finds numerous applications in radio, TV, and industrial electronic work. When applied in TV receiver circuits, the probe permits the user to isolate trouble in weak or dead stages. Tests can be made in the rf tuner, video if amplifier, picture-detector, video-frequency amplifier, audio if, audio-frequency, sync and sweep circuits.

Perhaps one of the most interesting features of the new probe is the fact that tests of high-level stages do not require electrical contact with the circuit, as illustrated in Fig. 2. The operator can test the horizontal-output stage for example, by merely holding the probe tip against the glass wall of the tube, and capacitive transfer of pulse voltage provides ample meter indication. A typical indication of 1 v is obtained in this test for a normally operating stage.

**Increased Resistance Range**

Another interesting new accessory probe is shown in Fig. 3; here a leakage test is being made on a fixed capacitor by means of a high-ohm probe. The probe provides an additional high-resistance range on the VOM, by converting the Rx10,000 range to an Rx100,000 range. In making the resistance scale 10 times more sensitive, the ohmmeter indicates resistance values up to 200 megohms when the probe is utilized; without the high-ohms probe, the ohmmeter can indicate resistance values only up to 20 megohms.

Operation of the probe is made possible by use of three transistor batteries and a suitable multiplier resistor. Not only can resistance values 10 times higher than usual be measured, but the high-ohms probe also increases the accuracy of indication of resistance values in the range in the interval from 1 to 20 megohms; the higher accuracy is obtained by indication of these values on the expanded portion of the ohmmeter scale, where the observational error is negligible.

Because the probe is battery-powered, the batteries eventually require replacement after extended service. This point is reached when the operator can no longer zero-set the pointer on the meter scale by means of the zero-adjust control on the VOM. However, extended life is realized from the batteries, since the current drain is very low. A maximum current of 50 μA is required during tests.
Hundreds of aircraft electrical circuits, adding up to thousands of feet of wire, are tested in minutes by an analyzer connected by Hubbell Interlock Plugs. Only a locking contact, such as Interlock provides, can assure the uninterrupted flow of current and accuracy required for this vital circuit testing... and only plugs that disconnect so quickly and easily, when circuit changes are necessary, would be feasible in a mass wiring set-up such as this, used by Trans World Airlines, Inc. Hubbell Interlock Plugs and Connectors play an important part in this, as in a wide variety of applications that require absolute accuracy of readings. They are used by some of the world's largest manufacturers of electrical and electronic equipment.

*Circuit Analyzer manufactured by DIT-MCO, Inc., Electronic Division, Kansas City, Mo.

For Complete Information On Other Interlock Products, Write
ARVEY HUBBELL, INC.
Interlock Electronic Connector Dept., Bridgeport 2, Conn.

CIRCLE 36 ON READER-SERVICE CARD FOR MORE INFORMATION
THREADED fasteners can be vibration-proofed with a new liquid sealant. Heavy vibration does not loosen the locking action but simple torque tools easily separate the threaded hardware.

Manufactured by American Sealants Co., Trinity College P.O. Box 260, Hartford 6, Conn., Loctite is a clear, low viscosity liquid with the property of hardening automatically when confined between the surfaces of closely fitting metal parts. It forms a strong seal which is heat and oil resistant.

Loctite remains liquid if kept in its original container. It remains liquid as a film on the metal parts prior to final assembly. A penetrating liquid, it readily wicks into the joint between a nut and bolt. Maximum strength on hardening occurs in about 24 hours following the assembly operation.

Metal threaded fasteners can be treated in large lots by tumbling or can be individually coated with a felt or cotton swab, hand-dipped into a container of the fluid or drop dispensed from a bottle. One 10 cc bottle treats 1,000 #10 machine screws.

Loctite is found to work well with all metals and can be used as a substitute for lockwashers and pins. The sealant is not recommended for organic and lacquer type finishes. Loctite treated assemblies may be painted after degreasing.

Hardened sealant can be removed with hot caustic soda. Excess sealant can be removed with
Liquid Lock Washer

It cannot be true — But,

Here is what the new A-B hermetically sealed composition resistors will do!

Unaffected by humidity or moisture
Humidity and moisture have been nuisance factors to all composition resistors. The type of hermetic sealing built into the new A-B Type TS and Type ES resistors entirely eliminates this possible objection.

Higher temperature rating
Special techniques have made it practical to increase the operating temperature beyond the rating heretofore considered “safe” with composition resistors.
(Type TS: .125 Watt...70°C, 0-derating at 110°C)
(Type ES: 1 Watt...70°C, .5 Watt...120°C, 0-derating at 165°C)

2% and 5% tolerances
The amazing stability incorporated in Allen-Bradley composition resistors has made a 2% tolerance a realistic and usable circuit design possibility.

Extremely low noise level
All microphonic noise, occasionally encountered in composition resistors due to shock and vibration, has been eliminated.

From 10 ohms to 500,000 megohms
Although normally supplied in the standard ranges from 10 ohms to 22 megohms, these resistors are also available for special applications in extremely high resistance values, the limits being determined largely by the capability of the measuring equipment.

Catastrophic failure impossible
For the first time a resistor is now available having characteristics approaching wire-wound “precision,” plus the established reliability of the A-B hot-molded composition units, assuring complete freedom from catastrophic failure.

Designed for manhandling
The hot-molded Allen-Bradley composition resistor in its ceramic enclosure and high temperature and seals results in an unusually rugged construction, possessing uniformity of size and configuration, making these resistors ideal for mechanical handling.

Allen-Bradley quality and uniformity
Experience gained from the production of hundreds of millions of hot-molded resistors, combined with typical Allen-Bradley quality control, has produced a resistor unique in performance and especially adaptable for the always increasing critical applications of military and computer circuit. You will want to become better acquainted with this new development in resistors! Representative values can be furnished for test.

Liquid Lock Washer

In the case of certain finishes, cadmium and zinc plating for example, the parts must be dipped in a degreasing solvent with 2% of Locquic activator and allowed to dry before applying Loctite and joining.

Loctite sealant is cheaper to use than all sizes of lock nuts and many sizes of sets. Usage determines which of several types of Loctite is required for a given application.

For further information on this product, turn to the Reader’s Service Card and circle 393.
A MYLAR* dielectric capacitor
MOLDED IN EPOXY

The superior moisture resistance of EPOXY gives far better humidity protection than commonly used molding materials. High dielectric strength is also an attractive property of this tough, dense plastic.

Leads are securely bonded in the EPOXY molding compound. This extremely tight bond prevents moisture from entering the capacitor at this point.

600-UE

Exclusive Good-All molding technique eliminates all possibility of deforming or otherwise damaging windings during the molding process. Uniform wall thickness is carefully maintained.

The dark maroon capacitor body is exceptionally durable as well as attractive. Since overall dimensions are held within close tolerances, this capacitor type is ideal for automatic machine insertion.

600-UE

The same quality features illustrated in the cut-away drawing are available in Pin Types for use in upright mounting.

GOOD-ALL TYPE 600

The outstanding combination of a space-saving Mylar winding sealed in moisture resistant EPOXY provides you with premium performance in a rugged compact design. This new capacitor incorporates these valuable properties of Mylar dielectric...HIGH IR, STABILITY WITH LIFE and LOW POWER FACTOR. Good-All Types 600-UE and 600-UPE (for upright mounting) are priced to encourage widespread use in both consumer products and industrial equipment.

SPECIFICATIONS

Insulation Resistance. Greater than 75,000 Megohm-Mfd. at 25°C (See curve below for higher temperatures)

Power Factor. Less than 0.5% from +25°C to +85°C

Temperature Range. May be operated at rated voltage from -65°C to +85°C and to +125°C with derating

Humidity Resistance. For surpasses requirements of RETMA Spec. REC-118-A

Voltage Range. 100, 200, 400 and 600 Volts D.C.

INSULATION RESISTANCE vs. TEMPERATURE

Temps. — Degrees Centigrade

Paper Dielectric capacitors are also available in molded Epoxy Types

Our engineers are ready to work with you on special applications. Write or wire for specifications and quotations.

GOOD-ALL ELECTRIC MFG. CO., O'GALLALA, NEBRASKA

A leading manufacturer of Tubular and Ceramic Disc Capacitors

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION

MULTI-MEDIA READER SERVICE

THIS 6-channel recording oscillograph offers, for the first time in one unit, the choice of three different media for recording. It permits the use of ink or electric-sensitive paper for curvilinear recording, or heat-sensitive paper for rectilinear recording.

Manufactured by Offner Electronics, Inc., 5328 N. Kedzie Ave., Chicago 25, III., the "Dynograph" makes possible the rapid substitution of one recording medium for another. The unit is equipped with inkwells and with stylus heating facilities. Styli are interchangeable when shifting from one medium to another and can be lifted from their cradles without the use of tools. The only part of the paper drive mechanism which must be interchanged is the pressure roll against the paper feed roll. For electric-sensitive recording the assembly is used...
Via Recorder

For a plot of actual results, the recorder, whether electric recording, or ink recording, is the same wire used.

The "Dynograph" employs a chopper amplifier which can be used for all applications. It is free of drift, yet has a sensitivity of 15 \mu\text{V/mm} of pen deflection. This permits strain gages to be excited with dc and avoids the complexity of carrier systems and their necessary reactance balance. The same amplifier can be used equally well with thermocouples for temperature recording, for all types of ac and dc recording, and with reluctance gages. In the latter application, the chopper converts ac to dc before application to the gage.

For additional information on this product, fill out the Reader's Service Card and circle 394.

Dynograph with inking styli.
This Type 240-A Sweep Signal Generator built by Boonton Radio Corp., Boonton, N. J., is designed to operate at controlled output levels down to 1/10 microvolt. To prevent RF leakage between the oscillator chassis and oscillator cover, Boonton engineers specified a METEX RF gasket at this critical joint. This METEX RF gasket, knitted of monel wire, prevents RF leakage so successfully that peak performance is obtained at minimum output levels where leakage was previously experienced.

METEX RF Shielding, knitted of monel, aluminum or silver plated brass wire, combines maximum conductivity for efficient performance with inherent resiliency that assures continuous line contact between imperfect mating surfaces. Interlocked loops, knitted of continuous wire strands, assure maximum cohesion.

If you have a problem involving RF shielding in electronics or related equipment, write METEX, today!
New Products

Miniature Transformers
For Transistor Circuits

A series of transformers is offered by this firm for transistor circuit applications. These units feature very small size, high efficiency nickel alloy cores, bobbin wound windings, and flexible coded leads. They have open type mountings.

Two interstage, one output, and one input transformer are available in 1 mw ratings, and another input transformer in a rating of 20 mw. Weight of the smaller units is 0.08 oz, and size is 11/32 x 3/8 x 3/8 in. The 20 mw unit weighs 1 oz and measures 3/4 x 5/8 x 5/8 in.

Merit Coil Products Co., Inc., Dept. ED, 4427 N. Clark St., Chicago, Ill.

Load Cells
Feature ±0.10% Linearity

These SR-4 universal-type load cells of 50, 100, and 200 lb capacity have been reduced substantially in size and designed with linearity (within ±0.10%) improved 100% over previous models. The principle of the bonded resistance wire strain gage is utilized in the cells. They measure 3-1/4 in. in height x 3-1/2 in. diam, permitting more compact SR-4 electronic weighing and control systems.


Noise Eraser
For Magnetic Tape

The N-HF "Noiseraser" is one of a series of bulk magnetic tape degausers. It contains a powerful magnetic circuit which removes recorded undesirable signals from entire reels of tape in a matter of seconds, 4-6 db below standard erase head levels of demagnetization. It is recommended for 1/4 in. magnetic tape on reels up to 10-1/2 in. diam, and it operates from the ordinary ac convenience outlet. Size is 7-3/4 x 4-3/4 x 3-1/4 in. deep. Weight is 8 lb.

Librascope, Inc., Burbank Div., Dept. ED, 133 E. Santa Anita St., Burbank, Calif.

Low Inertia Servo Motor
A Size 15 Unit

High reliability is featured in this size 15 servo motor. Class H and Class B materials are utilized to allow safe operation over temperatures from -60 to +120 C.

Input is 115 v, 400 cps. No load speed is 5000 rpm, and stall torque is 1.5 in.-oz. Bearings are stainless steel with special high temperature lubricants.

The motor is offered in two models: M-110 has a 13 tooth 120 pitch pinion, and M-111 has a 15 tooth 96 pitch pinion.

Basler Electronics, Inc., Dept. ED, Highland, Ill.

T/C Reference Junction
Withstands Missile Environments

This miniature, multichannel 'hot' thermocouple reference junction operates from ac or dc and is stable to 1.5 F. A maintenance-free unit, it replaces ice bottles and temperature compensators. The unit is rugged enough for missile use and can be provided with any type of junction required, such as iron-constantan, cromel-alumel, copper constantan, etc.

Arnoux Corp., Dept. ED-7, Box 34628, Los Angeles, Calif.

Subminiature Filters
For IF Amplifiers

This line of subminiature filters is designed for IF amplifiers for printed circuit use. The units are temperature compensated to ±0.15% from -55 to +85 C. Size of the filters is 13/16 x 2-1/2 x 2 in. high.

Units available for operation at 1.3 mc cover a 100 kc band width at 6 db, and 200 kc at 60 db. Units available for operation at 12.5 mc cover a 300 kc band width at 6 db, and 1100 kc at 60 db.

Burnell & Co., Inc., Dept. ED, 45 Warburton Ave., Yonkers, N.Y.

Products marked with a star are those being exhibited for the first time at the Radio Engineering Show, and include the company's booth number.

READER-SERVICE INFORMATION

CIRCLE 41 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 43 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 15, 1956
**New Moving Coil Pickup**

**Diamond Stylus**

"Microut" Diamond Stylus Pick-up, 225 Series, based on the high compliance moving coil principle, is flat to 20,000 cps with smoothly decreasing response beyond. Its low impedance (200 ohms) design provides average output of 5 mv which drives all modern amplifiers without requiring a step-up transformer.

Improvements in the mechanical assembly, which eliminate attraction for steel turntables, allow use of the Fairchild 225 with any changer. The low impedance moving coil permits up to 50 foot separation of phonograph from the preamplifier with no loss of high frequencies. Size, weight, and mounting dimensions are RETMA standards and fit all transcription arms and changers.


**Subminiature Tubular Capacitors**

**Mineral Oil Impregnated**

Impregnated with mineral oil, a subminiature metal-clad tubular capacitor is now being produced. To operate at 35°C, the unit is designed for "workhorse" applications in military electronic circuits.

Ratings of the units are 0.001 to 1.0 µf, at 100 to 600 v dc. Available tolerances are 5 per cent, 10 per cent and 20 per cent.

General Electric, Schenectady, N. Y.

**PISTON CAPACITORS AT WORK**

You're a jet fighter pilot streaking home to your carrier 200 miles distant . . . somewhere in the dead of night . . . above a pea-soup fog. No margin for error here . . . minutes, yards mean the difference between success and failure. Yet you're guided unerringly every second of the flight. Safely . . . swiftly you let down to home base—thanks to TACAN (Tactical Air Navigation).

Federal Telecommunication Laboratories specified the Model VC11 JFD Variable Trimmer Piston Capacitors in its TACAN development program for the U. S. Navy and U. S. Air Force. Used in the Ferris discriminator circuit of the IF amplifier, the VC11 is used in adjusting critical band pass frequencies to prevent adjacent channel interference. Compactness . . . stability . . . shock-resistance . . . imperviousness to temperature variations . . . these are a few of the reasons why today Federal Telephone and Radio Co., Hoffman Laboratories, Inc., and Stromberg-Carlson Co. (A Division of General Dynamics Corp.), are building JFD VC11 Capacitors into TACAN equipment.

The VC11 is one of 50 miniature and subminiature trimmer capacitors upgrading performance in today's most sensitive printed and conventional electronic circuits. Wouldn't you like to see how they can help you on your project?
weatherproof cannon plugs

Cannon "weatherproof" connectors include a range of types from moisture-proof to watertight. Each has been designed to meet one or several of these and intermediate requirements. A variety of sealing methods are used.

Potting types meet N.A.V. requirements.

Most rugged type is the "W" Series... with brass shells in 3 sizes, heavy acme threads, sealing rings, 50 insert arrangements. Requires sealing at entry by user.


Direct-Writing Oscillograph
Greater Flexibility

Two-channel, direct-writing oscillograph providing instantaneous, permanent recordings of frequencies as high as 250 cps at one-inch double amplitude, and consisting of a type 5-301 Datagraph and a type 1-133 Amplifier, can record voltages from practically any source. Almost any input device is suitable because of the instrument's high input impedance.

Since the recording system uses no ink, traces are clean and can be interpreted easily. Speed-change push-buttons select six chart speeds from 0.05 to 20 in. per second, and separate control knobs set the trace density for each of the two channels. Timing pulses are provided automatically at one pulse per second, or up to five pulses per second by external means. A manual "event marker" push-button can be used to mark the chart at any time.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 52 ON READER-SERVICE CARD

New Battery Types
For Transistorized Radios

Three new battery types, VS304, VS305 and VS306, are especially designed for use in transistorized radio receivers. Together with three previously announced types, VS300, VS301 and VS400, they are intended for replacement use in transistorized portable radios currently marketed by many leading manufacturers of electronic equipment.

Five additional types are also being added to the RCA battery line at this time for experimental work in transistorized applications. These are types VS307, VS308, VS309, VS310 and VS311.

RCA, Dept. ED, Harrison, N. J.

CIRCLE 53 ON READER-SERVICE CARD

MINIATURES, TOO!

CIRCLE 51 ON READER-SERVICE CARD

Stainless Steel Nameplates
Last Lifetime In Extreme Conditions

New 0.002 in. stainless steel Foilcalbs that are non-corrosive, non-fading, and have extremely high abrasion resistance are being manufactured. These new Foilcalbs are especially made to withstand excessive abrasion or extreme weather conditions.

This new product comes in two finishes, dull and electro-polished bright, and lends itself to applications on products where high style is desired. A wide range of color selection is available for etched sunken or etched raised letters.

Various types of adhesives can be furnished, eliminating the use of metal fasteners. Foilcalbs can be applied to curved or wrinkled surfaces.

Miller Dial & Name Plate Co., Dept. ED, 4400 No. Temple City Blvd., El Monte, Calif.

CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION

Expanding Mandrels
Straight Jaws

New patented countercentric expanding mandrels with straight jaws provide an extra long bearing surface over a wide bore range, longer than any other standard expanding mandrel, and permit a greater bore expansion without change of jaws or sleeve.

Permanent jaws maintain built-in precision of Le Counts' count-centric mandrels to 0.0005 in. T.I.R. for type "B" and to 0.0002 in. T.I.R. with Type "SB". Permanent jaws maintain built-in precision and permit heavy cuts without chattering. Only 14 precision tools provide for every bore size from 3/8 to 3 1/4 in.

A miniature duplicate of the "Count-Centric" straight jaw mandrels is the type "MM" and "SM" Micro-Mite expanding mandrel. This smaller version is designed to enable precision instruments and electronic manufacturers to achieve miniaturization without the cost of special holding devices. Only six standard tools provide every arbor size from 1/4 to 3/8 in.

The Le Count Tool Works, Inc., Dept. ED, 390 Capitol Ave., Hartford, Conn.

CIRCLE 57 ON READER-SERVICE CARD FOR MORE INFORMATION

THERMAL CONDITIONING OF ROCKETS AND GUIDED MISSILES

WHERE CAN YOU USE G-E SPECIALTY HEATING EQUIPMENT?

Whenever your equipment requires thermal conditioning, General Electric specialty heating equipment can help. G.E. has had extensive design and manufacturing experience in providing controlled heating for a wide variety of applications. These applications range from giant guided missile blankets to tiny one-inch-long accelerometer heaters. Problems of intricate shape, large or small size, unusual environmental conditions, and amount of heat required have all been solved.

LETT US ANALYSE YOUR HEATING PROBLEM; a General Electric specialty heating expert is available and a prompt answer is assured.

FOR MORE INFORMATION contact your General Electric Aviation and Defense Industries Sales Office or send coupon.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 58 ON READER-SERVICE CARD FOR MORE INFORMATION
new Adjust-A-Volts
Motor-driven variable transformers
for remote control operation

You'll like the design and performance of these compact, durably constructed motor-driven units for commercial and military applications where remote control of variable voltage by push button or switch is desired.

They have all the features of manually operated Adjust-A-Volt variable transformers plus a standard 115 V, 60 cycle motor, all enclosed in a well-ventilated and protective grey wrinkle finish case.

Choose from twenty-two basic models—single or up to 6 ganged assemblies with a load rating range from .35 to 28KVA—115 V or 230 V input.

Full range travel speeds of 6, 13, 26, or 45 seconds available to suit your need. All units are equipped with clockwise and counter-clockwise limit switches.

Send for your copy of the new 22 page Adjust-A-Volt catalog A56 which describes and illustrates the entire Adjust-A-Volt line and features dimensional drawings and a specification and application index.

STANDARD ELECTRICAL PRODUCTS CO.
2240 E. THIRD ST. • DAYTON, OHIO, U.S.A.

CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Kits
For Analog Recorders

“Digitizer” Kits can be connected to Minneapolis-Honeywell “Electronik” null balance recorders to convert analog data such as temperature, pressure, voltage, strain, etc., into digital form for recording on Clary Printers, punched cards, and perforated paper tape machines. These kits can be installed in a few minutes without machining of any kind with standard equipment and parts furnished with the assembly.

With this approach, the existing method of recording remains unchanged for direct comparison with the digital data. The accuracy, sensitivity, and response of the recording instrument remains unaltered.


CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

New X-Band Rotary Joint
High Stability

Model H25OT/S61 rotary joint is a broad band, high power waveguide coupler designed especially for operation under severe shock and vibration conditions.

Capable of operating at 600 kw peak power for short intervals, the rotary joint will operate at 350 kw during extended use. Impact and vibration tests per MIL-T-17113 show unimpaired mechanical operation and no internal damage.

Preloaded ball bearings provide maximum mechanical reliability and minimum change of electrical characteristics during rotation. VSWR is less than 1.10 over a frequency band of 8400-9600 mcs. Change of VSWR with rotation is less than 0.2 db.

Waveguide and mounting flanges are readily supplied to customer specifications as an integral part of the rotary joint, eliminating blind soldered seams and other potential breakdown points.

Litton Industries, Components Div., Dept. ED, 5573 Rodeo Rd., Los Angeles 16, Calif.

CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

SWITCHBOARD-PROVED
Plugs and Jacks

The veteran of telephone equipment supplies
STROMBERG-CARLSON
offers you the plugs and jacks which survive the torture test of PBX switchboard work!

No matter what programming or patch panel project you have, we doubt if it will subject plugs and jacks to a tougher test than daily use by a telephone switchboard operator.

We've been making these products for this purpose for over half a century. Their ruggedness and dependability are attested by service records in telephone companies from coast to coast—and in installations of our armed forces all over the world.

A CATALOG of Plugs and Jacks has just come off the press and will be mailed to you on request. Or write to the address below for a specific need you may have.

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS CORPORATION
TELEPHONE INDUSTRIAL SALES
116 CARLSON ROAD, ROCHESTER 3, N. Y.
CIRCLE 63 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 15, 1956
Replacement for Coaxial And Waveguide Transmission Line

The G-Line is a new economical single wire surface wave transmission line assembly designed to eliminate coaxial transmission line and waveguide in low power microwave and television broadcasting.

Designed for high efficiency operation at frequencies from 1700 to 2400 mc, the G-Line assembly consists of a modified copper wire, coupled at each end with identical rf field transformers (launcher and collector). The transformers serve to couple the transmission line ends to the coaxial feed line and provide an efficient transition between the radial field on the wire and the transverse electric field in the coaxial feed line. A simple, highly efficient de-icing system is built into each rf transformer.

Power rating is equal to RETMA 7/8 in. 50 ohm air dielectric line. Operating wire loss is extremely low, +0.5 db per transformer.

The G-Line is simple to install, requiring no bends, complicated plumbing, no pressurization and little maintenance.

Prodelin, Inc., Dept. ED, 307 Bergen Ave., Kearny, N.J.

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

Potentiometer Rated to 200 C

The Model 875T is a high temperature precision potentiometer rated to 200 C. It is a servo-mount subminiature single-turn rotary precision unit with a power rating of 2 w at 150 C. Despite its small 7/8 in. diameter, linearity is ±0.5% or better, and resolution is as high as 0.06%. Precious metals are utilized in the coil and wiper to permit low contact pressure and to provide long, noise-free life. Potentiometer coils can be supplied with taps, and as many as six sections can be ganged on a common shaft.

Electromechanical Div., G. M. Giannini & Co., Inc., Dept. ED, 918 E. Green St., Pasadena 1, Calif.

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION
P&B answers newest jet bomber relay need
puts big performance in tiny package

Modern supersonic aircraft call for an entirely new concept of relay performance and miniaturization. Vital relays must have incredible sensitivity ... multiplicity of action ... unquestioned reliability. And they must be smaller than ever before!

Yet P&B has engineered and produced a relay for the world's most spectacular jet bomber, now in experimental production, that meets all these demands.

Though details of application are restricted, we can tell you this. The new P&B unit is really 19 individual relays in one 6" x 6" x 5" package that actually outperforms a previous unit nine times the size!

Your relay requirements may not be those of a jet bomber. But whatever your problem or application, "standard" or special, you can be sure you too will find the answer with the relay leader... P&B.

Write for your new Engineering Guide today.

Decade Counters
Are Plug-In Units

Decade counters 140, 40 and 140-100 are used to count electrical pulses. Functionally, the counters do two things: provide one output for every 10 input pulses and record on the digital scale the number of pulses that occur after the last output pulse has been delivered.

One decade counter is required for each place (units, tens, hundreds, etc.) in the quantity being counted. The counters are connected in cascade, the output pulse of one driving the next in line, each counter dividing its input by 10 and displaying the remainder.

The 140-100 has a max mounting rate of 100 kc and the 140-40 a max rate of 40 kc. Power requirements of these units are 6.3 v ac at 1.2 amp, and +300 v dc at 14 ma. Dimensions are 1-1/2 x 5-1/2 x 5-1/4 in. Weight is 3/4 lb approx.

Northeastern Engineering, Inc., Dept. ED, Manchester, N. H.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

Rubber-Housed Light
Shock and Vibration Proof

Existing shock and vibration problems in aircraft lighting can be readily overcome by the all-rubber housing of the "Rubb R Lamp." Completely encased in rubber, socket and bulb are cushioned against jarring.

Additional features of the design are weather tightness, ease of installation and maintenance, and application flexibility. Held securely within a locking ring on the rubber base, snap-out lens, and the leads, wires, are sealed dust-and-moisture-proof. Molded of rubber, the body can be fabricated in any desired configuration for panel lights, and aircraft applications, and is slipped quickly in and out of retaining brackets for inspection.

Specifications: 2 1/2 in. over-all body diameter, 1 1/2 in. over-all depth of the lamp, 11/16 in. deep back of the mounting groove, plastic coated, 16 gauge lead wire, and any bulb voltage.

The Lighthouse, Inc., Dept. ED, 2315 Gran Ave., Los Angeles 7, Calif.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION
Digital Voltmeters
Use Mercury Contact Relays

Three digital voltmeters are offered by this firm for applications demanding continuous precision operation. Known as Models 1300, 1400, and 1500, they employ mercury wetted contact relays which assure a life expectancy of more than one billion accurate readings.

Model 1500 (5 digits) has manually-selected ranges of 00.000 to ±99.999 v dc with resolution of 0.001 v, and ±100.00 to ±999.99 v dc with resolution of 0.01 v. This instrument gives three complete readings per second with automatic polarity indication. Absolute accuracy is ±0.01% of value read, or ±one digit. Input impedance is 11 megohms. Size is 10-1/2 x 15-1/2 in., mounting in a standard 19-in. rack.

Model 1400 has a 4-digit readout, and Model 1300 has 3 digits, but they offer the same basic features as the Model 1500.

Non-Linear Systems, Inc., Dept. ED, Del Mar Airport, Del Mar, Calif.

CIRCLE 74 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Potentiometers
Meet Military Specs

Designed to meet rugged military specifications, these versatile, 1/4-w miniaturized controls are completely enclosed. They can be sealed or potted, making them valuable for miniature amplifiers, geophysical equipment, guided missiles, and scores of other applications where small size and high quality are primary factors. There are 28 different selections, all with a tolerance of 20% and in resistance ranges from 1000 ohms to 2.5 megohms.

The model JP has a 1/8-in. diam plain round shaft 1/2-in. long; its bushing is 1/4-in.-32, 1/4-in. long, and is furnished with mounting nut and lock washer. The model JL has a screwdriver slotted shaft of 1/8-in. diam; its split locking bushing is 1/4-in.-32, 3/8-in. long, and is furnished with a jam nut, mounting nut, and lock washer.


CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D.C. (Silver Spring, Md.)

Canada: Dow Corning Silicones Ltd., Toronto; Great Britain: Midland Silicones Ltd., London; France: St. Gobain, Paris
To users of ceramic parts...

is THERMAL SHOCK giving you trouble?
Stupakoff offers a number of ceramic bodies providing exceptional resistance to thermal shock, the most outstanding being STUPALITH, which has withstood over a hundred cycles from 2000° F to liquid air without harm.

are HIGH TEMPERATURES your problem?
Components formed of selected Stupakoff Ceramic Materials will withstand extremely high and prolonged temperatures, without deterioration, even in the presence of many corrosive gases and materials.

would PRECISION-MADE CERAMICS help speed your production?
Stupakoff specializes in the mass-production of precision-made ceramic parts and components. Tolerances of ±0.001 in. are not unusual. Their use in assemblies of electrical and electronic equipment sharply reduces assembly costs, and assures correct functioning of the equipment in service. This precision is particularly valuable in miniaturized assemblies.

Write for the new Stupakoff Ceramic Data Chart

STUPAKOFF
DIVISION OF
The CARBORUNDUM Company
WRITE DEPT. ED
LUTRROE, PENNSYLVANIA
CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION
Delay Lines
Continuously Variable Units

Seven continuously variable delay lines are offered for use as components or as test equipment in the design and development of advanced computer and radar systems. In these lines, a single control shaft, in 10 turns, covers the entire delay range from zero to maximum delay. A locknut attachment can be supplied to lock as desired delay. Therefore, the lines can be used as components in equipment with a fixed delay, or as continuously variable units.

Attenuation in these units is less than 1.0 dB. Resolution is better than 0.001 μsec. Termination is external. Outside dimensions are 6-17/32 x 5/8 x 1-1/4 in. The units meet all applicable Mil specs. Delays are available from 0.10 μsec (max to 0.70 μsec (max), in rise times from 0.25 μsec to 0.60 μsec. In addition this firm can supply custom-designed units.

ESC Corporation, Dept. ED, 534 Bergen Blvd., Palisades Park, N.J.
CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Power Supplies
With Voltages to 30 kV

The Models 15BR and 30BR are resonant transformer rf type high-voltage supplies particularly well suited to the requirements of low ripple, fine regulation, and maximum safety. The high frequency power is generated by two self-oscillating power tubes. The rectifier is air insulated and consists of a single half-wave rectifier in the Model 15BR and a doubler half-wave rectifier in the Model 30BR. Corona and flashover are virtually non-existent.

Regulation is obtained by comparison of a sample of the output with a constant voltage, and the difference is fed to a dc amplifier which controls the screen voltage of the power tubes.

Voltage range of the two units is 2-15 kV and 5-30 kV dc, with current output of 1 ma at 10 kV and 1 ma at 20 kV respectively. Regulation of both units is better than 1 per cent. Input is 117 v 60 cps. Size is 7-1/4 x 10 x 8 in. and 7-1/4 x 14 x 8 in. respectively.

Neutronic Associates, Dept. ED, 87-16 116th St., Richmond Hill 18, N.Y.
CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION
Plastic Insulation
Reinforced but Flexible

Grade FM is a low cost glass-mat polyester plastic insulation available in flexible form suitable for bending around corners or wrapping in cylindrical forms. It is heavy enough to give substantial mechanical support, flexible enough (in 1/32 in. thickness) to bend to a 3 in. diam without loss in dielectric strength, and heat-resistant enough to withstand continuous exposure to Class B temperatures (130°C) without loss in dielectric strength.

The material provides savings both in labor and material cost, due to the need for less wraps because of greater thickness. It offers excellent dimensional stability and low moisture absorption even after prolonged heat exposure. It is valuable for motor and generator phase insulation, transformer core wrapping and end filler stock, curved barriers for switch gear, and other applications where flexible Class B insulation is required. It is currently available in standard thicknesses of 1/32, 3/64, and 1/16 in., in sheet sizes up to 36 x 72 in.

The Glastic Corp., Dept. ED, 4321 Glenridge Rd., Cleveland 21, Ohio.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Gear Box
Has Two Outputs

Available in a wide variety of ratio combinations, the Dual Output Gear Box, Model 013, provides primary and secondary output shafts for use in servo systems where two constant ratio outputs are required. The unit minimizes space consuming gear arrangements, and in some instances it completely eliminates a servo system which may otherwise be needed to provide the additional output.

The gear box is adaptable to scaling problems where two different operating speeds are required, or where one fast positioning speed and a slower speed are needed, as in recorders. It may also be used where a constant ratio is required between any two functions—minutes/seconds, hours/minutes, days/hours, etc. Adapter kits are available to facilitate utilization with various standard servo motors.

Link Aviation Inc., Dept. ED, Binghamton, N.Y.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION
Precision Potentiometer
Close Tolerance

Precision potentiometers are 2 in. diam single-turn units for servo or bushing mounting, with or without hall bearings; up to 8 sections can be ganged on a common shaft at the factory, with as many as 21 taps to a section.

A wide range of total resistance is provided, from 35 to 80,000 ohms, and linearity as close as ±0.15% is available.

The series 5600 is a continuous-rotation potentiometer, with electrical rotation of 360° ±1°. Housed in a dimensionally stable, one-piece plastic cup, it weighs 3.2 ozs. Operating range is -55 to +80 C. Power rating is 4.8 at 25 C ambient and 3.5 at 40 C ambient.

Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

Standard Capacitor
Provides 0.2% Accuracy

A precision decade three-terminal standard capacitor, the Type FT-KGM has an accuracy of 0.2%.

It is designed for use as a laboratory standard, for calibration of capacitance bridges and meters, for development and laboratory testing of integrators, computers, and low-level ac amplifiers, for a variety of circuit measurements, and for use as a component in laboratory constructed circuits, such as bridges.

The three terminals permit the unit to be used as a grounded or ungrounded component, as desired. It, also, has double shielding which may be interconnected. Owing to the capacitor's high resonant frequency (approximately 0.35-11 mc, depending on the capacitance switched in) the FT-KGM is useful over a wide frequency range. Total capacitance range of the unit extends from 100 mfd to 1.00 mfd. Settings are made on three decade scales and one continuously variable air capacitor scale. The units weigh 22 lb and are 9 x 9 x 12-1/2 in. wide.

Federal Telephone and Radio Co., Instrument Div., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION
Power Generators
Provide up to 100 va

Model DP line of Electronic Power Generators, capable of delivering up to 100 va of low-distortion power at any fixed frequency between 50 and 5000 cps, is available for laboratory and production applications. These instruments feature an accurate 4 in. meter that continuously monitors the generated voltage, in both stand-by and operating conditions.

Four standard models (400, 1000, 1600, and 2000 cps) are available in two versions: single, factory set frequency, or variable frequency, panel-controlled over a range of ±5% of nominal. Any non-standard output frequency can be specified, and tuning fork-stabilized instruments similarly can be tailored to meet exact requirements.

Long term frequency drift is less than 1% from no load to full load with a transient recovery time of approximately 10 ms. Model DP measures approximately 17 1/2 x 9 x 11 in. deep and weighs 60 lb. It can also be provided in a standard 19 in. rack mounting.

Trio Laboratories, Inc., Dept. ED, 4025 Merrick Rd., Seaford, N.Y.

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION

Angle Socket
Used in Printed Circuits

This new angle socket has been designed for use in electrical and electronic units in conjunction with printed circuits. The socket provides for the mounting of tubes in units where there is limited height, and for maintenance and servicing accessibility where circuit boards are plugged vertically into larger units or terminal strips.

Extreme structural rigidity is provided by supplementary buttress ribs which maintain the angle position of the socket to the printed circuit. Structurally, the ribs will withstand great pressure so that the socket cannot be bent out of position or torn from the circuit board.

Cleveland Metal Specialties, Dept. ED, 1783 21st St., Cleveland 14, Ohio.

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

Note these special features:
- AM, FM, CW, MCW, and PULSE reception.
- Uni-dial control.
- Direct reading.
- Broadband coverage.
- Output level reading directly in db.
- High sensitivity.
- Seven interchangeable plug-in r-f tuning units cover the entire frequency range.
- Low noise figure; excellent gain stability.
- Microwave preselection, tracked and double-tuned, used in the plug-in tuning units covering the range 400 to 11,260 mc.
- Audio, video, and trigger outputs.
- Special recorder output.
- High video output—low impedance.
- AGC and AFC circuits.

For these applications:
- General communications.
- Field intensity meter.
- Frequency meter.
- Measurement of radiation and leakage of microwave devices.
- Measurement of bandwidth of microwave cavities.
- Measurement of relative power of fundamental and harmonic signal frequencies.
- Measurement of noise figure.
- Antenna field patterns.

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION
Three new r-f tuning units double the frequency range of the well-known Polarad Microwave Receiver. Now more than ever the Model R becomes a basic multi-purpose instrument for microwave research and production in the field, in the laboratory, and in the factory.

This receiver is designed for quantitative analysis of microwave signals and is ideal for the reception and monitoring of all types of radio and radar communications within the broadband 400 to 22,000 mc. It permits comparative power and frequency measurements, by means of its panel-mounted meter, of virtually every type of signal encountered in microwave work.

It is compact and functional, featuring 7 integratedly designed plug-in, interchangeable RF microwave tuning units to cover 400 to 22,000 mc; non-contacting chokes in pre-selector and microwave oscillator to assure long life and reliability; and large scale indicating meter for fine tuning control.

Call any Polarad representative or direct to the factory for detailed specifications.

**SPECIFICATIONS:**

Basic Receiver, Model R
Tuning Unit Frequency Ranges:
- Model RR-T: 400 - 1,000 mc
- Model RL-T: 950 - 2,040 mc
- Model RS-T: 1,290 - 4,320 mc
- Model RM-T: 4,190 - 7,720 mc
- Model RKS-T: 7,260 - 11,260 mc
- Model RKS-T: 9,500 - 15,600 mc
- Model RKU-T: 14,700 - 22,000 mc

Signal Capacities:
- AM, FM, CW, MCW, pulse
- Sensitivity: 2
- IF Bandwidth: 3 mc
- Video Bandwidth: 2 mc
- Image Rejection: Greater than 60 db

Input AC Power: 115, 230 V ac, 60 cps, 440 watts
Input Impedance: Models RR-T through RX-T: 50 ohms Models RKS-T & RKU-T: waveguide

VSWR: Less than 4:1 over the band

Range of Linear Gain: 60 db

Receiver Type: Superhet/gy

Maximum Amplifier Input: 1.500,000

Trigger Input: Positive 10-volt pulse across 100 ohms

Audio Output: 5 volts undistorted, across 500 ohms

FM Discriminator: Deviation Sensitivity: 7 v/mc

Sensitivity: 60 db - 6 db bandwidth ratio less than 5:1

IF Rejection: 60 db

Price: Model R-B (basic unit) $1,500

- Model RR-T
- Model RL-T
- Model RS-T
- Model RM-T
- Model RKS-T
- Model RKS-T

Prices subject to change without notice

Immediate maintenance available by field service specialists

**18 lb Alternator**

An improved version of the "Nobrush" Alternator is offered in ratings up to 750 va, three phase. They include such features as: light weight, small size, high efficiency, freedom from rf disturbance, immunity to damage by overload and short circuit, and resistance to impairment by dust, grit, or moisture. Improvements in the basic design result in greater rigidity of frame, more rugged shaft design, improved ventilation, and more thorough stator insulation. Maintenance problems have been reduced virtually to bearing attention; for intermittent duty, this attention is obviated by use of sealed-for-life ball bearings.

Greater flexibility in output voltages and in multiple voltages has been attained. Single phase ratings range from 125 va to 500 va. Ratings from 125 va to 750 va, three phase, are available. The alternator has dimensions of 7 x 7-5/8 x 2-1/8 in., exclusive of shaft, and weight is 18 lb. For many applications, intrinsic regulation is adequate, obviating regulating equipment. The alternator may be mounted in any position and works equally well with clock-wise or counter-clockwise rotation. By addition of rectifiers, a brushless dc generator may be obtained.

Georator Corp., Dept. ED, Manassas, Va.

**Molded Resistors**

Meet MIL-R-10509B

Made to meet or exceed MIL-R-10509B, the DCM 1/8 and DCM 1/4 molded deposited carbon resistors are rated 1/8 w and 1/4 w respectively. They are designed for applications requiring precision, stability, and small physical size. They are doubly insulated, resulting in better mechanical protection, long load life, high electrical insulation, and high resistance to moisture.

The DCM 1/8 has a resistance range of 10 ohms to 1 megohm, length of 13/32 in., diameter of 0.186 in., and a lead length of 1-1/2 in. The DCM 1/4 has a 5 ohm to 1 megohm range, a length of 19/32 in., a 0.219 in. diameter, and a lead length of 1-1/2 in.

Electra Manufacturing Co., Dept. ED, 4051 Broadway, Kansas City, Mo.

**Polarad Electronics Corporation**

43-20 34th Street - Long Island City 1, New York

**REPRESENTATIVES:** Albuquerque, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Dayton, Denver, Fort Worth, Kansas City, Los Angeles, New York, Philadelphia, Portland, St. Louis, San Francisco, Schenectady, Syracuse, Washington, D. C., Winston-Salem, Canada; Arnprior, Ontario. Resident Representatives in Principal Foreign Cities

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 15, 1956
Got A Small "Black Box" Crammed full of Electronic Equipment?

The Model 'M' ACRO micro-switch
Unsurpassed in all these ways...

- REPEATABILITY
- FUNGUS PROOF
- VIBRATION RESISTANT
- LOW CONTACT RESISTANCE
- TEMPERATURE RANGE +165° F. to -90° F.
- DIMENSIONALLY STABLE AT ABOVE TEMPERATURES
- WIDE RANGE OF OPERATING FORCES
- CLOSE MOVEMENT DIFFERENTIALS

HELPFUL SWITCH APPLICATION GUIDE
Whether your problem is meeting rigid government specifications for weather and altitude or controlling circuits on sensitive electronic equipment, this data in charted form will greatly simplify your switch selection. Write for Data Sheet M-1.

"The Biggest Line of Little Switches"

ACRO SWITCH DIVISION
COLUMBUS 16, OHIO
Plants at Columbus and Hillsboro, Ohio
REPRESENTATIVES IN ALL PRINCIPAL CITIES

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

Transducer Detects Small Flaws

The "High Resolving Transducer" can detect small flaws close to the surface of a specimen by ultrasonic echo sounding methods. This transducer is also to differentiate between two defects in the same minute area.

When a 10-me 3/4-in. diam high resolution transducer is used with a suitable instrument (such as the Curtiss-Wright "Immerscope") it is possible to detect a round plane flaw of only 0.0017-sq in. area at a distance of only 0.1 in. below the top surface of an aluminum specimen.

These transducers are also available modified to meet special requirements, such as: special acoustic matching to the immersion fluid; beam focusing to any reasonable depth; and special shapes, such as a rectangular broad-beam "paint brush" style, for rapid automatic scanning of large surfaces. Broad-beam transducers up to 6 in. wide have already been delivered.

Industrial and Scientific Products Div., Curtiss-Wright Corp., Dept. ED, Caldwell, N.J.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

Polystyrene Capacitors
Both Round and Flat

A line of molded polystyrene capacitors is offered in both round and flat molded configurations. The units are designed for all phases of the electronics industry with particular emphasis on radio and TV equipment. They provide high insulation resistance, low dielectric absorption, good stability, a linear temperature coefficient, and a "Q" of greater than 2000.

Both the flat and round models are of extended foil construction, molded in a thermostetting alkyd resin, and have axial leads. Inserted tab construction and special lead configurations also are available. Dielectric absorption is 0.05%, with insulation resistance at 25 C of 1 x 10^12 ohms. Power factor at 1 kc is a maximum of 0.05%. Temperature range is -55 to +85 C, with coefficient of -100 parts per million per deg. The capacitance range is 0.0001 mfd to 1 mfd.

Condenser Products Co., Div. New Haven Clock & Watch Co., Dept. ED. 140 Hamilton St., New Haven, Conn.

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

KEL-F® Plastic grade 500

New fluorocarbon plastic formulation provides wire insulation that can withstand continuous operating temperature up to 175°C.

KEL-F PLASTIC, Grade 500—like all the molding compounds in the KEL-F fluorocarbon series—is notable for its extreme resistance to high temperatures, chemical attack, humidity and abrasion.

Of special interest to the electrical field is the higher heat-aging level of wire coatings with the new Grade 500. Tests on wire insulation indicate a continuous operating range of temperatures up to 175°C. Samples of coated wire exposed to temperatures as high as 190°C for extended periods of time (2-3 months) still maintain relatively high voltage breakdown values.

TWO TYPES AVAILABLE
GRADE 500-F, a less crystalline type that resists embrittlement by high temperatures. Recommended for general wire and cable insulation, hook-up wire, thin wall tubing, and spaghetti.
GRADE 500-R, possesses some general properties as F type, only a slightly more rigid formulation. Recommended for use in connector insulation and for coil forms.

MOLDABILITY
The new Grade 500 permits extrusion of high molecular weight coatings and thin wall tubing that resist embrittlement when exposed to higher temperatures.

TECHNICAL SERVICE
Our Technical Customer Service staff will be happy to work with you in developing specific applications for the new Grade 500. Send for your copy of the first report on KEL-F PLASTIC, Grade 500. Write:

THE M. W. KELLOGG COMPANY
Subsidiary of Pullman Incorporated
Chemical Manufacturing Division
P. O. Box 469, Jersey City, N. J.

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CIRCLE 109 ON READER-SERVICE CARD
CIRCLE 395 ON READER-SERVICE CARD
Starting half a century ago, Stackpole engineering centered around two of the most basic, versatile elements . . . carbon and graphite. Singly, in combination or mixed with metal powders, these age-old elements were developed into materials and components that consistently met advanced engineering requirements in many fields.

With the commercial advent of radio, this specialized experience provided a head start for the production of composition resistors.

Thus established in 1928, the Stackpole Electronic Components Division expanded rapidly in full keeping with the remarkable growth of the industries it serves.

Today’s electronic lines, as illustrated on the following pages, offer convincing evidence of the progress that has been made . . . progress that continues today at an accelerated pace.
In addition to complete ranges of standard component types listed here, Stackpole regularly develops and produces special designs and adaptations for quantity users. Full details on any Stackpole component gladly sent on request.

STACKPOLE COMPONENTS
in 1928

This sample kit of almost 30 years ago includes Stackpole fixed and variable resistors and automotive ignition suppressors.

Electronic Components Division
STACKPOLE CARBON COMPANY, St. Marys, Pa.
Plants in St. Marys, Pa. (2); Kane, Pa. (3); Johnsonburg, Pa.
and Toronto, Ontario.
STACKPOLE

**FIXED Composition RESISTORS**

Stackpole's position as one of today's major resistor suppliers is based on two factors: (1) Consistently dependable, quality-controlled resistors, and (2) close personal service in matching resistor requirements and in assuring "on time" deliveries. ½−, 1- and 2-watt sizes are supplied in all standard RETMA ranges and tolerances.

STACKPOLE

**SLIDE SWITCHES**

Over 20 inexpensive types for radio and TV receivers, instruments, appliances, small motors, electrical toys, battery-operated lighting circuits and many others. Switch Bulletin RC-10D sent on request.

STACKPOLE

**POWDERED IRON CORES**

Outstandingly uniform. Insert, cup, sleeve, threaded, choke coil, side-molded and plain core types. Stackpole Preferred Type "EE" cores meet 8 out of 10 needs at prices substantially less than custom cores.

STACKPOLE

**MOLDED COIL FORMS**

Standardized, low-cost types stocked for prompt delivery. Molded of high-resistance powdered iron with firmly-anchored, easy-to-solder wire leads.

STACKPOLE

**LINE SWITCHES**

Types to provide practically any switching arrangement for Stackpole Variable Resistors. Similar switches with outside toggles provide dependable switching for record changers, push-button tuners and other units.

STACKPOLE

**VARIABLE RESISTORS**

Single, concentric shaft duals, and new midges including types for transistorized sets. Write for handy Volume Control Chart for quick guide to Stackpole standard units.

STACKPOLE

**PERMANENT MAGNETS**

These new, low-cost ceramic magnets are extremely resistant to demagnetization, even when exposed to strong opposing fields. Use no critical materials. Are virtually electrical non-conductors. Require no "keepers" or other closed-circuit conditions. Write for new Stackpole Ceramagnet Bulletin RC-10A.

STACKPOLE

**LOW VALUE CAPACITORS**

The simplest, most economical fixed composition capacitor types yet produced. Operating stability is adequate for the great majority of uses. Values from 0.10 to 10.0 μF, each stamped with RETMA color code.
In addition to the Electronic Components shown on the preceding pages, Stackpole makes the Carbon, Graphite and Metal Powder products illustrated above. Write for details on any product.

STACKPOLE CARBON COMPANY, St. Marys, Pa.
Thermostat
Controls Two Separate Circuits

Two independent electrical circuits can be controlled simultaneously with the Series 22000 dual-control "Thermoswitch." Basically, this thermostat consists of a liquid-filled sensing element, containing a sensitive bellows-and-push-rod assembly which actuates two precision miniature snap switches mounted in the head. Each switch may be connected to operate a separate electrical circuit. This thermostat has many applications in equipment where two controls or signals are desired, and offers the advantages of simplified installation and mounting.

The thermostat can be specified to operate over one of three ranges: −75 to +125°F, 25 to 225°F, and 100 to 300°F. Each switch can be set in the field to actuate at any temperature within the service range. A differential setting arrangement is also available; the differential between the switches may be specified from 0 to 200°F.

Switches are available to handle up to 20 amp at 125 v or 250 v ac, or 10 amp at 125 v dc. In addition, a choice of switches is available to provide a standard (±1°F) or narrow (±0.5°F) operating differential, and for high inrush or moisture-proof service. The sensing bulb is 5/8 in. diam by approximately 3-3/4 in. long, and is furnished either with a flange mount or a threaded fitting, depending on mounting requirements.


CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

Mounting Base
Takes Two Binding Posts

This mounting base is used for quick assembly of two binding posts to make a dual unit. It is designed to receive the Model No. 29-1 Binding Post having an OD of only 1/2 in., and for 3/8 in. mounting holes on 3/4 in. centers. It is available in red or black thermosetting phenolic (MIL-P-14, type CFG). This material will withstand approximately 285°F without distortion.

Grayhill, Dept. ED, 581 Hillgrove Ave., La Grange, Ill.

CIRCLE 113 ON READER-SERVICE CARD FOR MORE INFORMATION
Large Screen Oscilloscope
12-Channel Multi-Trace

Model 2400 series multi-trace large screen oscilloscope utilizes a 17 in. kinescope to display simultaneously the 12 presentations of complex data waveforms.

Incorporated in this oscilloscope is a new method of electronic switching, which utilizes a switching rate of 20,000 cps, allowing a presentation of input waveforms with components of 2 kc or more. The number of traces is limited only by the physical size of the kinescope.

Each channel has its own individual controls for input, position, intensity and gain. Input circuits are balanced push-pull d-c coupled, having an input sensitivity of 10 mv for 1 in. deflection.

RYCOM Instruments, Dept. ED, 9351 E. 59th St., Raytown, Mo.

CIRCLE 117 ON READER-SERVICE CARD FOR MORE INFORMATION

Selenium Rectifiers
For Magnetic Devices

Type 61-2020, a single phase full wave bridge rectifier, is designed to deliver 90v d-c at 175ma for an rms voltage input of 130v max.

The rectifier occupies only 1 x 1-13/32 x 1-1/4 in. overall volume and can be mounted with a No. 8 (0.164 in.) machine screw, through the hollow brass eyelet.

Type 61-2020 combined with types D-3575F and 60-9150 gives the design engineer a wider range of single phase full wave bridge rectifiers with output voltages of 90 v to 180 v dc at currents of 100 ma to 175 ma.

International Rectifier Corp. Dept. ED, El Segundo, Calif.

CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION

Do you think about Angular Acceleration?

Boeing does

...and uses Statham Angular Accelerometers to test...

Statham unbonded strain gage liquid rotor angular accelerometers offer a simple, reliable means for the study of the rotary motion of a test body under conditions where a fixed mechanical reference is not available. For static and dynamic measurements in ranges from ±1.5 to ±5,000 rad/sec², four standard models are offered.

Please request Bulletin AA2

CIRCLE 119 ON READER-SERVICE CARD

TANTALUM CAPACITORS...DEPENDABLE SINCE 1930

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION
New Metal Patterns
Geometric Designs

Six new embossed metal patterns have been introduced. Wicker Weave (#650) is a pattern of embossed interlocking links measuring approximately three per inch, for panels, automotive interiors and exteriors, kick plates, and semi-bold application.

Chain Mail (#652) is an overall pattern of debossed grooves resembling ancient armour plate, for decorative effects on hardware, appliances, or lighting fixtures, as well as radio and TV applications.

Block (#700) and Grid (#702) are bold patterns suggesting uses on refrigerators, freezers, counter trim, and also can be furnished with perforations for speaker grilles.

Baguette (#800) is a continuous pattern of baguette-diamond shapes of jewel-like quality, for gift items and small appliances.

Roman Brick (#802) resembles continuous stacks of tiny bricks debossed into the metal and separated by a slender rib, for application where a delicate pattern is desired.

Patterns, in gages ranging from 0.012 to 0.040 in. are furnished in unfinished or in anodized, lacquered, and plated finishes.

Coroito Div., Croname, Inc., Dept. ED, 3701 N. Ravenswood Ave., Chicago 13, Ill.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Transformers
For Special Applications

These pulse transformers, capable of high voltage and high peak power, are especially suited to military radar applications. They are constructed according to customer specifications. Also available is a line of special plate and filament transformers, if and interstage transformers for military applications, and magnetic binary transformers.

Laboratory for Electronics, Inc., Dept. ED, 75 Pitts St., Boston 14, Mass.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

Operating at 100°C (212°F)
Fansteel High Temperature Rectifiers deliver full rated power output, continuously, with no derating whatever. At temperatures up to 150°C (302°F), only moderate derating is necessary.

Fansteel High Temperature Rectifiers are available in all standard cell sizes and all standard circuit arrangements and with all standard protective finishes—moisture resistant, fungus resistant and a salt-spray resistant finish that meets MIL specifications. The table indicates a partial list of over 100,000 available types.

Send for bulletin 6.401
New, Ultra-Miniature Model 6 1/10-Watt Variable Resistor

Resistance range, 500 ohms to 10 megohms

For applications where small size and high quality are factors...

- On-off switch completely enclosed within control. Rated 2.5 amps at 2.0 v.d.c.; 0.1 amp at 45 v.d.c.
- Tested to a minimum of 25,000 complete cycles. Seven standard tapers.
- Smooth, noise-free operation.
- Variety of mountings available.


Centralab

A DIVISION OF GLOBE-UNION INC.

9601 East Keefe Avenue • Milwaukee 1, Wisconsin
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario

CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION

Laboratory Hygrometer
Provides Pin-Point Accuracy

Model 101 is specifically designed for professional use where pin-point accuracy is required by experimental centers, particularly those conducting environmental tests on electronic products, paints and similar items.

It provides precise measurements over a range of 10-100% relative humidity. Individual calibration of the element within the reader results in a measurement of better than 1%. This model operates from conventional ac line frequency and is compensated for line voltage variations.

EL-Tronics, Inc., Dept. ED, 1420 Walnut St., Philadelphia, Pa.

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION

Six Channel Recorder
Used with Analog Computers

This Six Channel “REAC” Recorder, designed specifically for use with analog computers, automatically records reference data. Pen zero, attenuator setting, and electrical offset for each channel, as well as paper speed, are recorded on the chart at the start of each run. These reference data are recorded at a speed independent of the actual paper speed setting. As soon as the data are entered, the computer and recorder are both switched automatically to “operate”, and the run is thereafter recorded at the rate to which the speed switch is set. A “zero-time” marker indicates the point at which the run began.

All standard computer controls are provided on the recorder; thus the entire computer installation may be operated from the recorder. Eight paper speeds are available, ranging from 1-250 mm/sec. The paper table is horizontal, and placed at convenient writing height. Frequency response is uniform to 60 cps. Full scale voltage ranges from ±1 v to ±200 v, with eight attenuator settings, provide voltage control between the ranges of 0.05 to 10 v/mm.

Reeves Instrument Corp., Commercial Products Div., Dept. ED, 215 E. 91st St., New York 18, N.Y.

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION
Vibration Exciter
For Environmental Test Chambers

The Model C25HB is an oil-cooled electro-dynamic vibration exciter designed specifically for environmental test chambers. It has high performance ratings, also useful in normal atmosphere testing. The exciter may be operated continuously at its full rated sinusoidal force output of 3500 lb or 5000 lb (depending on the power supply and as limited by displacement), and equivalent acceleration in a frequency range from 5 to 2000 cps at chamber altitudes from 0 to 125,000 ft, relative humidities from 0 to 95%, and temperatures between -100 and +300 F.

The exciter may be rotated 90° on its trunnion and operated in any position from vertical to horizontal. The specimen table is a flat, circular surface, which simplifies the installation of a temperature and humidity shield in conjunction with a hood for chambers with limited cooling capacities. The exciter can be mounted on a special motorized dolly, which may be rolled in and out of the chamber. The dolly has jacks to raise the exciter and to lower it on neoprene "Isomode" units.

The exciter is used with electronic or rotary power supplies and either manual or automatic control systems.

MB Manufacturing Co., Dept. ED, 1060 State St., New Haven, Conn.

CIRCLE 132 ON READER-SERVICE CARD FOR MORE INFORMATION

Gain and Phase Analyzer
For Color TV Measurements

The type 2036, a differential gain and phase analyzer, is intended primarily for measuring the transmission characteristics of color TV networks. It is designed for use with any standard stair-step generator having a 3.58-Mc subcarrier. It features a high impedance input, extremely high sensitivity, and low noise, together with a unique differential gain presentation. A precise, continuously variable, 360° phase shifter makes the Type 2036 particularly suitable for color signal certification and large differential phase measurements.

Tel Instrument Electronics Corp., Dept. ED, 704 Garden St., Carlstadt, N.J.

CIRCLE 133 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW TRANSFORMER DEVELOPMENTS...

Westmold and Westseal types resist moisture and heat

NEW WESTMOLD TRANSFORMERS—offer exclusive dimensional fidelity, flame resistance and greatest resistance to moisture penetration ever available in an open-type transformer (where MIL-T-27 grades 2 and 5 are required). This new type is molded in a plastic material which maintains its flexibility at extreme temperatures. Will withstand shock of being heated to 130°C, then plunged into -55°C alcohol-dry-ice. Ten of these cycles are passed without cracking, complying with Type C thermal shock test, MIL-C-16923. Dimensional fidelity is assured as the shape of the transformer is fixed by the mold in which it is poured.

NEW WESTSEAL TRANSFORMERS—Small, lightweight power transformers and filter chokes have been developed for radar, airborne electronics and other applications demanding good resistance to humidity and high temperatures (where MIL-T-27 grades 2 and 5 are required). They are impregnated with a newly-developed solventless silicone resin and sealed with an impervious coating of silicone rubber.

The compound is firmly bonded to the transformers and to the terminals, eliminating any "wick" action. Coils are completely filled, free of voids. Result—corona-free operation in the 5000-volt range.

For further details, circle the proper number on the Reader-Service Card, see your Westinghouse Sales Engineer or write to Westinghouse Electric Corporation, Specialty Transformer Division, P. O. Box 231, Greenville, Pa. J-70772

WATCH WESTINGHOUSE!

COVER THE PRESIDENTIAL CAMPAIGN ON CBS TV AND RADIO!
Signals can get crossed-up here

...but your relays have to be right every time in this league!

Extreme reliability and highest quality—these are two necessary requirements in today's relays, whether they are used in air traffic control systems or in guided missiles. Even the smallest percentage of failure among the hundreds of relays employed in such highly complex automatic devices renders costly equipment unusable. Backed by Elgin's universally recognized reputation for extreme precision in craftsmanship and manufacture, Elgin Relays give you the dependability your product must have. That's why they're specified by major manufacturers everywhere. Shouldn't you contact Elgin...now?

ELECTRONICS DIVISION
ELGIN NATIONAL WATCH COMPANY
Elgin, Illinois

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

Rotary Solenoids
New Small Model Added

The smallest of eight basic sizes, the Model BD1E rotary solenoid weighs 1-1/2 oz and has a diameter of 1 in. Starting torques for the entire line now range from 0.2 lb-in. for the new size to 54 lb-in., based on ampere-turns for normally intermittent duty cycle and rotary stroke of 45 deg.

Standard rotary strokes for the BD1E are 25, 35, and 45 deg, either clockwise or counterclockwise. Voltage requirements of 2-200 v dc can be accommodated with coil wire gages ranging from No. 25 to No. 40.

All eight models employ the same principal of operation. The magnetic pull moves an armature along the solenoid axis, and this linear action is efficiently converted into rotary motion by ball bearings on inclined races. The resulting snap-action power can be harnessed with a minimum of linkages.

G. H. Leland, Inc., Dept. ED, 123 Webster St., Dayton, Ohio.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Tachometer Generators
Weigh Approximately 3 oz

A line of low cost dc tachometer generators is offered with diameter of 1 1/8 in. and weight slightly more than 3 oz. Although used principally as rate generators in servo systems, these units have many other uses. When combined with a standard 1000 ohms/v voltmeter, they make an excellent direct-reading tachometer. They can be used as under or over speed indicators, speed synchronizing controls, and for numerous other applications.

Output voltage is proportional to speed better than 1/2%, with ripple well under 3%. Various models are available with output voltages as high as 15 v per 1000 rpm. Output voltage for either direction of rotation is held to a tolerance of better than 1/4%. Various mounting arrangements are provided, and a choice of models is ready for immediate delivery from stock.

Servo-Tek Products Co., Inc., Dept. ED, 1068 Goffle Rd., Hawthorne, N.J.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

STOP BREAKAGE!
Get Automatic's New HIGH-STRENGTH Rotor Shafts, Plunger Rods & Connecting Rods!

Stop worrying about the breakage problem of ceramics and steatite. Automatic's "Hi-Strength" rods and shafts are the revolutionary answer to the problem of transmitting mechanical motion to electrical components without electrical loss.

SHOCK PROOF...
"Hi-Strength" rods have 5 times the tensile, 4 times the flexural and 12 times the impact strength of steatite.

LOW LOSS...
Special formula fiberglass insures excellent electrical characteristics under most operating conditions.

Compare the physical and electrical properties of Automatic's "Hi-Strength" with steatite as tested and certified by the United States Testing Laboratories, then specify "Hi-Strength."
Frequency Indicator
Counts up to 9999 Events/Sec

Model 7340A Frequency Indicator and Counter is offered for counting and recurrence rate measurement of mechanical and electrical events. The instrument is valuable for such applications as rpm measurement, oscillator calibration, direct counting, and flow measurement.

Counting and indication with automatic decimal point location are easily read from glow transfer tubes directly in events per second ranging from 1 to 9999 events. A precision synchronous motor establishes the gate time (from 1 sec to 10 sec) during which input events are counted. For gate times longer than 10 sec or for cases where a straight counter is desired a manual gate switch is provided. For applications requiring a permanent record of readings, the instrument can be delivered as the Model 7341A (illustrated) with outputs for driving a serial type print-out.

Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistorized Servo Amplifier
Hermetically-Sealed, Plug-In Type

Primarily intended to receive signals from a synchro control transformer, and to operate a size 15, 400 cycle, 6.1 w servo motor or equivalent, this new servo amplifier is designed to meet the environmental requirements of Specification MIL-E-5400.

Physical properties are: 1-3/16 x 1-11/16 x 3-13/16 in. high; 6 oz; flat black finish; 7-pin plug-in, hermetically sealed connector; three 6-32 weld mounting studs. Electrical properties: 10,000 ohms input impedance (also available in other ranges); typical voltage gain of 750 at 3.5 w output, 200 at 6 w output; internally adjusted phase shift to provide essentially zero phase shift, 380 to 420 cps carrier frequency; 40 v rms max output (6.1 w) at 400 cps when used with Kearfot Type R110-S Servo Motor; torque at this voltage is 1.45 oz-in.; 28 v dc at 300 ma.

M. Ten Bosch, Inc., Dept. ED, Pleasantville, N.Y.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION

To perform a specific function in a specific manner calls for custom design. To cool a tube efficiently, keeping airflow and circuit losses at a minimum, calls for a thermo-electrically designed air socket.

Eimac's line of 16 air sockets provides these advantages for nearly all Eimac multi-grid and klystron tube types.

Pictured above is the SK-100, for the 3K3000L series klystrons. Below it the SK-400, for the 4-400A. Next is the SK-600, for the 4X250B. And finally the SK-300, for the 4X5000A. Each is the best for its own specific function. And each is an original Eimac custom design. There are 12 others, every one as outstanding.

Among these 12 is the SK-630. Developed for use with Eimac's 4X150A, 4X150D, 4X250B, 4X250F, and 4W300B in tropical atmospheres, it employs an encapsulated screen-to-cathode bypass capacitor which, in combination with shielded circuits, permits stable high gain operation up to the tube's highest useful frequency.

Eimac air system sockets chimneys are also available.

For further information, write our Application Engineering Department.

EIMAC
EITEL-MCCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes
Leak Detector
Tests Pressure and Vacuum

This portable leak detector is capable of exacting tests of either evacuated or pressurized systems. Known as Type 24-210, it can be used to show the existence or absence of extremely minute leaks, to determine the rate of leakage, and to pinpoint the exact location of a leak. The instrument is a simplified mass spectrometer which responds only to the presence of helium as a tracer gas. By probe or air-sampling methods, it will detect one part of helium in 300,000 parts of air.

Applications include testing hermetically sealed parts, refrigeration units, high-vacuum systems, drums and other containers, or any other product which depends on a perfect seal. A 145-lb unit, it is 20-1/2 in. high and requires a table area of only 18-1/2 x 22 in. It operates on 105/125 v ac.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

Corona Tests
May Be Repeated Frequently

A self-contained and non-destructive Corona Test Set, which enables simple and accurate corona testing for research, development or production requirements, includes all the necessary circuit refinements and controls to permit a continuous and adjustable output. An overload relay protects the specimen and the power unit in the event of a short circuit. Accurate voltage indication is provided for with a triple range kilovoltmeter at the output terminals. Special sweep circuits provide a straight line oscilloscope trace with recurring corona pulses occupying the center of the trace. The presence of noise will not detract from the clear presentation of these pulses. The set can be equipped with a motorized output control to enable the gradual application of test voltage at uniform rates of 500 or 1000 v per second.

The Peschel Set meets ASTM, MIL, JAN and IPCA specifications. Standard sets are available from small portable units to very large sets of up to 100 kva capacity and in voltages up to 30 kv. Special units can be manufactured with voltages up to 50 kv.

Peschel Electronics Inc., Dept. ED, 15 Garden St., New Rochelle, N.Y.

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION
New Miniature POWER OUTLETS
For Small Electrical and Electronic Units

- SMALLEST MADE
- TAKE STANDARD PLUG
- MOUNT FROM TOP OR BOTTOM OF FLAT BRACKET
- CHOICE PRE-WIRED STYLE OR WITH SOLDERING TERMINALS
- PHENOLIC BLOCK HAS BARRIER TO PREVENT SHORTS

AC and DC

No. 221 (above) with soldering terminals and steel bracket with 6 clearance mounting holes. Also No. 222 with 6-32 tapped mounting holes. No. 223 (left) with 8#-14 or #10 plastic wire leads and steel bracket with 6 clearance mounting holes. Also No. 224 with 6-32 tapped mounting holes.

KULKA ELECTRIC MFG. CO., Inc.
Manufacturers of Electrical Wiring Devices
MOUNT VERNON, N. Y.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION

New BRADY Aluminum Foil Wire Markers
-Give Permanent Identification

Stick and stay in elevated temperatures, oils, most solvents

New Brady Aluminum Foil Wire Markers show which wire goes where at a glance. Permanently identify machine tool electrical systems, motor leads, control circuits, etc.

Only 3 mils thin. Self-Sticking Markers wrap around wire fast. Legends imbedded in the foil stay permanently legible. Markers stay on wire under oily conditions—won't discolor at temperatures to 350°F.

NEMA and NMTBA Markers in stock for immediate delivery. Specials made to your order. Write today for free working samples, prices, and name of local distributor.

W. H. BRADY CO. Est. 1874

783 W. Glendale Ave. Milwaukee 9, Wis.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

Nylon Tubing
Withstands High Temperature

This large diameter thin-wall “Zytel” nylon tubing is for use in the electronic, chemical, and processing industries. Chemical resistance, flexibility, high burst strength, and the good dielectric properties of the tubing make it valuable for handling of liquids and for use as an electrical insulating medium. The material can be held to a close tolerance and is easily joined together to custom fit job requirements.

The tubing is insoluble in common solvents, alkalies, dilute mineral acids, and most organic acids. Unlike most theroplastics, it does not soften gradually as the temperature is raised. It has a relatively sharp melting point and it loses little of its many properties at temperatures below 300°F; when subjected to load, service temperature should not exceed 275°F.

Keystone Plastics, Inc., Dept. ED, 2331 Morris Ave., Union, N. J.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

Time Delay Relay
Permits Electrical Interlock

A time delay relay which allows electrical interlock and two step timing, the Model NETL “Agastat” is a combination unit with two normally closed microswitches and a basic “Agastat” relay.

Contacts of the microswitch are on the front side of the relay and are held in the open position by a lever before energization. Upon energization of the relay coil, the contacts close instantly, locking in the circuit. The two step timing action then takes place. A second microswitch attached to the bottom of the relay provides the two step timing; the switch has a cam adjustment that varies the timing between the two steps. This is in addition to the timing adjustment on the basic unit.

The relay is made with dial head adjustment. It is available for ac or dc, intermittent or continuous duty, in spdt double-break, and dpdt single-break models. It is rated 15 amp at 115 v 60 cps.

A’Ga Div., Elastic Stop Nut Corp. of America, Dept. ED, Elizabeth, N. J.

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION
New

X-500

Sub-Miniature

ACEPOT*

rated to

150° C.

ACEPOTs and ACRETRIMS meet unusually rigid functional and physical requirements and are setting new standards for dependability in miniaturization. The designs are the result of 4 years' development and over a year of successful use by leading electronic and aircraft equipment manufacturers.

Condensed Engineering Data

ACEPOT

| Resistance Range | 200 to 250K ± 2% |
| Size            | 1/4 x 1/4”       |
| Linearity       | ± 3%             |
| Resolution      | Extremely high   |
| Ambient Temperature | -55° C to 150° C |
| Torque          | Low or high      |

The above specifications are other values on special order.

All units sealed, moistureproofed, and anti-fungus treated. Meet applicable portions of JAN norms and MIL-E-5722 standards.

Ace also offers larger size precision potentiometers, to RETMA specifications, manufactured to highest standards to meet your most rigid requirements. Expedited delivery from special order section.

For applications where you must be positive, answer your potentiometer and trimmer needs with space and weight saving, highly accurate and dependable ACEPOTs and ACRETRIMS.

Expedited delivery on prototypes; prompt servicing of production orders. Write for Fact File and application data sheets.

*trademarks applied for

For Capacitors and Resistors

The Model CRA-2, a capacitor-resistor analyzer, is for use in industrial and military electronics, black and white and color TV, and all related fields. A vacuum tube ohmmeter circuit displays accurate insulation-resistance values on the meter for many types of capacitors. The extended range calibrated power factor control permits power factor measurements of electrolytic capacitors rated low as 6 v and as high as 600 v dc. This special "Quick Check" circuit performs rapid "in circuit" tests for shot, open, intermittent high rf impedance, and high power factor without removing or disconnecting the component from its operating circuit.

When making leakage current measurements with the instrument, the values are read directly from the meter while the rated operating voltage is applied to the capacitor.

Pyramid Electric Co., Dept. ED, 1445 Hudson Blvd., North Bergen, N.J.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

STEMAG PRESENTS

THE FIRST CAPLESS*

FILM RESISTOR

1w Regular Carbon Film 1w patented STEMAG Resistor with end caps.

Now you can obtain long life stability of carbon film resistors with small size and low price of carbon composition types. Available in the same wattage ratings, dimensions, tolerances and color code as carbon composition type resistors.

NOTE THESE FEATURES:

- Derating: 75° C. (1/2 w type)
- Load-Life Test: MIL-R-111 max. change 1.3 %
- TC: 200 to 400 PPM per °C
- Lead Connection: Direct capsless contact inside resistor body
- Noise Level: Extremely low. No noise generating end caps
- Tolerances: ± 5 % and ± 10 %
- Sizes: 1/8, 1, 2 watt

For complete specifications and test data write to:

Arnhold

ARNHOLD CERAMICS, INC.

1 East 57th St., New York 22, N. Y.
Line of Test Equipment
Wired Units at “Kit Prices”

Latest additions to the test equipment line are the LSG-10 Signal Generator, the LC-4 Capacitance Resistance Tester with “in set quick check” feature, and the LC-15 Capacitance-Resistance Checker.

The LSG-10 Signal Generator has a frequency range of 120 kc to 260 mc, up to 180 mc in fundamentals.

The LC-4 C.R. Tester has four direct reading scales from 0.00001 to 100 mfd, two resistance ranges from 100 ohms to 5 megohms, and uses magic eye as a null detector.

The LC-15 Capacitance Resistance-Checker checks for open shorts, leakage, and intermittants, in ranges from 0.00001 to 1000 mfd, and from 100 to 5 megohms.

Lafayette Radio, Dept. ED, 100 Sixth Ave., New York 13, N. Y.

CIRCLE 163 ON READER-SERVICE CARD

Teflon Lead Wire
Precision Components

Capable of continuous operation up to 300 F, teflon lead wire remains extremely stable, in that it does not give off corrosive vapors when subjected to various adverse conditions such as: corrosive solvents and chemicals, sunlight, high temperatures, etc.

Available in 12 to 32 awg, in solid or spiral striped color codings, Hi-temp lead wire meets MIL-W-16878 type E and EE specifications.

Hi-temp Wires, Inc., Dept. ED, Mineola, N. Y.

CIRCLE 164 ON READER-SERVICE CARD

Military Environmental Testing
New Facility

A new environmental testing facility is available for conducting tests in accordance with MIL-E-5272A, military environmental test specification.

Facilities are complete for functionally testing electronic, fuel, hydraulic and mechanical components and systems while these equipments are undergoing environmental qualification of reliability tests.

Parameters Inc., Dept. ED, 195 Hericks Road., New Hyde Park, N. Y.

CIRCLE 165 ON READER-SERVICE CARD

CIRCLE 166 ON READER-SERVICE CARD
**NEW PHAOSTRON**

**EXPANDED SCALE AC Voltmeter**

NOW!...all the time-tested proven Phaostron features...PLUS UP TO TEN TIMES GREATER READABILITY for greatly increased accuracy!

Phaostron has squeezed down that under 90V portion of the scale, where you don't need it, and expanded the section where you need it most—between 90 and 130V. Precisely calibrated 1 volt scale increments provide greater reading accuracy. Wide frequency range—linearity—true rms reading and Phaostron craftsman construction.

Phaostron Custom Panel Meters, with expanded scale, 90V to 130V AC rms, are available in nine types at your Paris Distributor. For special requirements, write to the Product Development Department for practical recommendations.

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**Portable Graphic Recorder**

Field and Laboratory Use

Frequency response recorder. Model SL-4, for electrical and electrical-acoustical measurements, utilizes a patented electro-dynamic principle for the operation of the pen or stylus. Specially featured are a variable, electronically controlled writing speed and pen damping movement.

The instrument records on a 4 in. wide chart at chart speeds of 4-1/2, 9, and 18 in. per minute selectable by manual controls. Other speeds can be furnished upon request. Various types of measurements can be recorded, since the scale function depends on the input potentiometer which can be furnished as a decibel, linear, square root or phone.

The dimensions of the SL-4 are 10-1/2 x 19 x 12 in., and the front panel is slotted for rack mounting. It can be conveniently linked with various oscillators, and analyzers. Link units are available for the most widely used beat-frequency oscillators and wave analyzers. Special link units and corresponding charts can be designed. The instrument can also be supplied with a chart take-up roll.

Sound Apparatus Co., Dept. ED, Stirling, N. J.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

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**Torque Motor**

Operated by Electronic Amplifiers

The Model 24 Torque Motor features fast response and high output force. It weighs only 11-1/2 oz and has an output conservatively rated at 8 lb of force for 3 w of input power. Designed to drive hydraulic servo valves or similar mechanisms, it may be operated by electronic, magnetic, or even transistor amplifiers.

The stroke is a full ± 0.010 in. and is proportional to input differential current. The armature is symmetrically designed so that large lateral accelerations have virtually no affect on armature position. The unit operates in the -65 to 165 F range, but may also be ordered for operation at higher temperatures. A wide variety of coils are offered to match high and low impedance driving sources.

Raymond Atchley, Inc., Dept. ED, 2340 Sawtelle Blvd., Los Angeles 64, Calif.

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

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**ADVANCED DESIGN ... today!**

**STAND-OFF and FEED-THRU INSULATORS**

MINIATURE and SUB-MINIATURE

Self-sealing and self-fastening Shamban Stand-Off and Feed-Thru Insulators help guided missiles reach ever higher...cut assembly costs in radar, television, and other electronic equipment. Resistant to heat, pressure, humidity, mechanical shock and vibration, they're another example of Shamban creative talents and engineering skill.

Write for Catalog

**SHAMBAH**

**ENGINEERING CO.**

11617 W. Jefferson Blvd., Culver City, Calif.

You'll find Shamban thinking in every industry.

CIRCLE 170 ON READER-SERVICE CARD
**Missile Fire Control**

**Provides Automatic Programming**

Built to withstand the rigid environmental requirements of jet aircraft, the custom intervalometer is a hermetically sealed control that provides automatic programming for missile firing. Opening of rocket pods, rocket launcher extension, and other functions in complete and proper sequence of a firing mission are controlled to millisecond accuracies.

Rugged but lightweight mounting flanges are secured directly to the airframe. No special shock mounts are required to perform satisfactorily under extreme shock, temperature, and vibration conditions as outlined in MIL-E-5272, Procedure I.

Compact size, lightweight, extreme accuracy, and standard AN connectors are the predominate features of the fire control. Incorporated in some of the other intervalometers made by the firm is the "Chronopulse" time generator, a new type of high accuracy dc time base.

Abrams Instrument Corp., Dept. ED, 606 E. Shiawassee St., Lansing 1, Mich.

CIRCLE 173 ON READER-SERVICE CARD FOR MORE INFORMATION

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**Paper Tubular Capacitor**

**Is Humidity Resistant**

This ceramic-encased paper tubular capacitor incorporates a newly developed thermosetting plastic end seal. It will pass humidity tests at 90-95 per cent humidity over a period of 750 hr at 40 C, 500 hr at 50 C, and 300 hr at 60 C. It will also pass a combination humidity and life test at 90-95 per cent humidity, 60 C, at rated voltage, as well as a boiling water test consisting of alternate 10 minute immersions in boiling water and water of room temperature for a total of five cycles.

Rated operating temperature range is -40 to +85 C. Available capacitance values cover the full range for tubular papers. The capitor is impregnated with mineral oil and has high insulation resistance as well as low power factor and temperature coefficient.

United Condenser Corp., Dept. ED, 3400-06 Park Ave., New York 56, N. Y.

CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION
Pulse Power Calibrator
Offers High Accuracies

Pulse Power Calibrator PCX-1 provides a new method for measuring the power of radio frequency pulses. The equipment gives an indication, which is essentially a notch-wattmeter display, but in addition eliminates all reliance upon a pre-calibrated condition. It provides a comparison scheme which is free of error caused by changes in voltage gain, input voltage fluctuations, parallax, or electronic instability about an operating point.

The equipment provides comparison circuits and bridge circuits which are energized rf power of the same frequency as the signal to be measured, thereby removing ambiguities produced by widely different frequencies between the calibrating device and the signal source to be measured. PCX-1 equipment provides a group of accessories required for interconnection with equipment under test, consisting of trigger cables, rf cables, cable connector adapters, and fixed attenuators. The calibrator's frequency range is 925-1225 mc. Accuracy is ±0.5 dbm. Power input range is -10 to +63 dbm. Input pulse width range is 0.5 to 10 μsec.

General Communication Co., Dept. ED, Boston 15, Mass.

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

Nuclear Photomultiplier
Cathode-Follower Preamplifier

A new preamplifier (Model NS31), a simple, inexpensive, versatile cathode-follower capable of stability and linearity demanded in normal scintillation counter spectrometry, features: prewired photomultiplier (DuMont 6292) socket, low noise and low temperature coefficient resistors used throughout, triode connected 6AH6 with 80 ohm output impedance, heavy base housing to permit either vertical or horizontal operation. Power requirements: 6/3 v at 0.45 amp FIL 180 v B+ at 10 ma. (Supplied directly by the N-301 non-overload amplifier).

Hamner Electronics Co., Inc., Dept. ED, P.O. Box 531, Princeton, N.J.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION
Regulated DC Source
For Unattended Installations

The Model MA65A is a low voltage, high current, tubeless regulated dc source utilizing magnetic amplifier circuitry for greater reliability. It is recommended for unattended installations because of its maintenance-free performance.

Input range is 105-125 v ac, single phase, 60 cps. Output voltage is 5.4-6.6 v dc, adjustable. Load range is 0-5 amp; ripple is 1% max. Regulation accuracy is ±0.2% against line or load (1/10 to full). Recovery time is 0.15 sec. The unit is supplied for rack mounting, with a cabinet available for bench use.

Sorensen & Co., Inc., Dept. ED, Fairfield Ave., Stamford, Conn.

CIRCLE 185 ON READER-SERVICE CARD FOR MORE INFORMATION

Tubular Rectifiers
Meet Rigid Space Requirements

Especially developed for high-voltage low current applications, these selenium tubular rectifiers are made in physical cell sizes from 1/8 to 1/2 in. diam and are rated 1-1/4, 2-1/2, 5, 10, and 20 ma per cell, in half-wave circuit using a condenser input filter. They are available for fuse-clip type mounting, with axial end leads or, for use under varying conditions of temperature and humidity, in hermetically sealed glass tubes.

The new cells have a reverse voltage rating of 33 v rms and are approximately 20% thinner than previous units. This higher rating and reduced thickness per cell offers a compact, efficient rectifying unit and permits rigid space and performance requirements to be met.

A new 33 v selenium power rectifier cell is also available. Cells range in physical size from 1 x 1 in. to 5 x 6 in. and are designed for stud, bolt, or bracket mounting. They feature "solid stack" assembly and are rated from 0.150 to 10.0 amp per cell on a single phase full-wave bridge basis in accordance with the latest NEMA approved specifications.

Union Switch & Signal, Division of Westinghouse Air Brake Co., Dept. ED, Pittsburgh 18, Pa.

CIRCLE 186 ON READER-SERVICE CARD FOR MORE INFORMATION
KOILED KORDS
THAT EXTEND AND RETRACT
Solve
MANY DESIGN
PROBLEMS...

KOILED KORDS retractile cords extend to approximately six times their retracted length. They are neat and orderly and never sag, droop, drag or tangle in moving mechanisms. Write for Bulletin KK-52 showing many uses.

ON
MACHINES
THAT MOVE

If the machine and power cord move, KOILED KORDS are the most effective and safest power cords to use.

ON
COMMUNICATIONS
DEVICES

KOILED KORDS are most convenient and can be quickly and neatly "stored" either inside or outside instrument housings.

ON
"IN-A-DRAWER"
EQUIPMENT

KOILED KORDS make it easy to service units that are concealed and they avoid possibility of ungainly straight cords causing mechanical failures.

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KOILED Kords
INCORPORATED

Box K, New Haven 14, Connecticut

KOILED KORDS is a trade mark of KOILED KORDS, INC. Manufactured by Whitney Blake Company.

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Amplifier
For Airborne Instrumentation

The Model 2HMA-2 is a dc amplifier with an isolated input circuit. It is particularly suited for airborne thermocouple or strain gage bridge measurements. Flight test applications where switches scan as many as 150 points/sec are easily handled by the amplifier's less than 5 ms rise time and flat response from dc to 400 cps. Amplifier output is 0-5 v dc for the input to an RDB telemetering system or magnetic tape recorder.

A "Second Harmonic Converter" is used as the input modulator in place of a mechanical chopper. The converter permits complete isolation of the input from the amplifier chassis and circuit ground, resulting in rejection of electrical noise and pickup from circulating ground loop currents. For temperature measurements, an automatic cold junction compensator can be provided for the particular type of thermocouple to be used.


CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

Control System
For Carrier Measurements

The Type 67 Universal Control System is a complete, miniaturized carrier measurement system available in various models to operate all types of transducers, including variable permeance, variable reluctance, variable differential transformers, strain gauges, potentiometers, and variable capacitance transducers. The unit measures by panel indicator or external recorder.

Components of the Type 67 are a regulated power supply, stabilized oscillator, adjustable ac bridge circuit, highly stable carrier amplifier, linear demodulator, and a panel read-out system, with indicator and 1000 division read-out dial. Single, two, and three channel models are available.

Crescent Engineering and Research Co., Dept. ED, 11632 McBean St., El Monte, Calif.

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

VERSATILE 'DIAMOND H'
Relays
Handle Many Different Jobs

"Diamond H" Series R hermetically sealed aircraft type relays perform outstandingly over a broad area that they are frequently used to do many different types of jobs in a given application. For example, they give excellent reliability in dry circuits yet will carry up to 10 amperes in power circuits... or even 20 amperes for reduced life requirements.

Savings inherent in uniform size and mounting arrangements for one relay family can be multiplied by the lower inventory of spare parts needed when a single model is used for two or more functions. Matching or surpassing requirements of USAF Spec. MIL-R-5757B, as well as important provisions of MIL-R-25018, tens of thousands of Series R 4 PDT and DPDT relays are in use, engineered for:

Various brackets of vibration resistance from 10 to 2,000 cps, temperature ranges from -65° to +120° C, coil resistances from 1 to 50,000 ohms, operational shock resistance of 30, 40 or over 50 "G" and mechanical shock resistance to 1,000 "G", contact capacities from 350 V., D. C., 400 MA, to 10 A., at 30 V., D. C., as well as signal circuits.

For complete information, send for a copy of Bulletin R-250.

THE HART MANUFACTURING COMPANY
210 Bartholomew Avenue, Hartford, Conn.

CIRCLE 192 ON READER-SERVICE CARD FOR MORE INFORMATION
Lacing and Winding Tape
Of Glass and Teflon

"Ben Har Braided Tapes," a line of lacing tapes for wire harnessings and windings, use duPont Teflon coated directly on glass fibers before braiding. A rough texture is achieved which improves the tying ability of the tape while eliminating the abrasive action of the glass.

The tape is applicable to a temperature range of -100 to +500 F, and remains pliable throughout the entire range. It does not shrink and cut through wire insulation. It is wax-free and will not support fungus growth; yet, because of the underlying glass braid, knots stay tight permanently. It is completely inert to most known chemicals and oils, is non-absorbent, and is practically ageless.

The new tape can be used in all wire harnessing where heat might be a deciding factor against conventional lacings. It is available in natural color (off-white) in 0.048, 0.062, 0.090, and 0.22 in. widths; in 250 and 500 yard spools, and a Universal 1/4 lb tube. Nine additional colors may be had on special order.

Bently Harris Manufacturing Co., Dept. ED, Conshohocken, Pa.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

Traveling Wave Tube
For the S-Band Region

Amplification over a wide range of frequencies in the S-band region can be obtained by the use of the 1161/BL850 Traveling Wave Tube. Peak power output of 1 kw can be obtained with an accelerating voltage of 5800 v. A magnetic field of 1000 gauss is required to focus the electron beam. Driving power needed is approximately 1 w. Average power output without forced air cooling is 1 w.

The tube is mounted in a metal capsule which supports it in the focusing solenoid and also houses the input and output matching cavities. Weight of the tube and capsule is 5 lb, and the tube is 17 in. long by 1-7/8 in. diam.


CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION
for printed circuits
PHILCO uses INSUROK® laminate

Philco engineers use Richardson Copper-Clad INSUROK T-725 laminate for printed TV and radio circuits.

In the manufacture of printed circuit materials, the most important single consideration is the laminate. Richardson Copper-Clad INSUROK T-725 is a laminate of outstanding excellence... Its electrical qualities remain remarkably stable under repeated temperature and humidity cycling.

For further information, write, or phone... Chicago number, MAIN 6-8900.

The RICHARDSON COMPANY
LAMINATED AND MOLED PLASTICS
Dept. 11, 2682 Lake St., Melrose Park, Ill.
CIRCLE 201 ON READER-SERVICE CARD FOR MORE INFORMATION

SANGAMO “GY” FLATPAK
Small Size
High Efficiency
Fast Starting
High Power Output
compact, efficient, dynamotor

The FLATPAK is a rugged, precision engineered dynamotor that is designed for mobile radio and general commercial use. It is of laminated field design, and its compact size makes it ideal for applications where space is a problem. Available in ratings through 110 watts continuous duty and 300 watts intermittent duty. Output to 650 volts.

Bulletin 1530 gives full information on these and other Sangamo Dynamotors. Mail the coupon for your copy.

SANGAMO Generators, Inc.
Dept. D, Springfield, Ill.
Please send me Dynamotor Bulletin 1530.

NAME
COMPANY
ADDRESS
CITY & STATE
CIRCLE 202 ON READER-SERVICE CARD FOR MORE INFORMATION

Synchronous Timing Motor
Develops High Torque

A new synchronous timing motor designated Series A2334 develops high torque while retaining the many advantages of hysteresis type motors. The motor is designed for high volume applications in the appliance, vending, animated display and industrial fields.

Torque rating is 10 oz.in at 1 rpm. Speeds of 1, 2, 4, 6, 8, and 10 rpm are available in right and left hand rotation. A heavy duty gear train permits transmitting continuously full output of the motor. Compactly constructed, the motor is only 1-13/32 from front to back.

Haydon Mfg. Co., Inc., Dept. ED, 245 E. Elm St., Torrington, Conn.

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION

Chassis Kit
Aids Experimental Work

The “Experimenter’s Chassis” kit provides quick set-up of electronic circuitry with simple hand tools. Although intended mainly for mock-ups, it is also suitable for more permanent use and may be mounted on racks or in cabinets with added adapter plates. The construction is highly flexible, and parts can be readily cut to make sizes other than those supplied.

The main wiring deck, consisting of a sheet of phenolic board having a uniform hole pattern, is mounted on aluminum channels. Decks are 4-3/4 x 8-1/2 in. or 4-3/4 x 17 in. and are packed with a variety of accessories.

An outstanding feature is the “Push-In Terminal,” which is a formed strip brass terminal having a partially tubular end that fits snugly into the holes of the board. The upper portion of the terminal has a narrow tapered slot with serrated edges. When a wire of any size between 0.030 and 0.045 in. is inserted, the fingers grip the wire firmly enough, so that for temporary testing the connections need not be soldered.

Vector Electronics Co., Dept. ED, 3352 San Fernando Rd., Los Angeles 65, Calif.

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION

At last!

- Positive Moisture Seal
- Perfect Strain Relief
- Arc-over Prevention
- Corona Suppression

IN SIMPLE, RUGGED CONNECTORS USING

ALDEN "IMI"
(integral molded insulation)
TECHNIQUE
(patented)

NOW — for the first time — you can seal connectors without tedious preparation, intricate assembly, or lengthy curing time.

INSTEAD — Alden “IMI” using the patented techniques shown above make it possible to mold the insulation directly around the contacts and leads in one compact, lightweight assembly.

This advanced technique has now made possible a whole new series of reliable connectors and unit cable assemblies. Write today for the new Alden “IMI” Connector Guide.

ALDEN PRODUCTS COMPANY
9139 N. MAIN ST., BROCKTON, MASS.

CIRCLE 205 ON READER-SERVICE CARD FOR MORE INFORMATION

MICRODOT data example
70 OHM

CABLES
Z0
70 ohms
C
21 mm/ft
α (400 mc)
.17 db/ft
V
70% (Teflon)
T
up to 400° F

CONNECTORS
"G" Screw Series
"QQ" Quick Connect
"GP" Pressurized

Available:
Plugs, Jacks, Receptacles, BNC Adapters, Feed-throughs and special designs.

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION
Portable MB Meter

MEASURES VIBRATION

This improved Model M6 vibration meter teams up with an MB Vibration Pickup to give you the facts on vibration. It measures voltage generated by pickup...directly in terms of amplitude, velocity or acceleration of the vibratory motions.

Four pickups can be connected to this meter...a push-button selector switch enables you to read any one at a time. Built-in 30, 70, and 110 cps high-pass filters are standard.

The meter is portable, compact, ruggedized and operates on standard AC. Write for more data.

MB manufacturing company
A DIVISION OF TEXTRON AMERICAN, INC.
1061 State Street, New Haven 11, Conn.

CIRCLE 208 ON READER-SERVICE CARD FOR MORE INFORMATION

specify standard

FLEXLOC SELF-LOCKING NUTS

Regular and Thin Types

Regular FLEXLOCs are one-piece, all-metal, standard height nuts that lock securely, even under extreme vibration. Thin nuts have the same one-piece, all-metal construction and the same positive locking principle, but these nuts are approximately 30% thinner. Your FLEXLOC industrial distributor stocks both types: regular FLEXLOCs in sizes from #6 to 2"; thin FLEXLOCs in sizes from #6 to 1/4". Ask him for catalog information and samples. Or write Standard Pressed Steel Co., Jenkintown 12, Pa.

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION

FLEXLOC LOCKNUT DIVISION

SPS
JENKINTOWN, PENNSYLVANIA

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscillator
Covers Acoustic Range

The A.F. Oscillator S16 gives an output from 30 cps to 30 kc in three ranges. It is intended for adjustment of af amplifiers in PA work and af stages in radio.

The output level is adjustable from 10 µv to 10 v by an accurate attenuator system. An automatic regulation circuit keeps the output level constant with changes in frequencies.

Output impedance is not more than 5 k. Distortion is 3 per cent for 30-50 cps and 2 per cent above 50 cps. Supply is 110-220 v, 50/60 cps. Size is 10-1/8 x 7-5/8 x 7-1/2 in. and weight is 12 lb 2 oz.

Compagnie Generale De Metrologie, Dept. ED, P. O. B. 30, Annecy, France.

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION

Recording Heads
For Computer and Electronic Uses

A line of multiple-channel magnetic recording and playback heads is offered for a wide variety of uses, such as computer input-output equipment, memory drums, disks, and telemetering recording. The audio field is also covered, with heads for 1/4 in. tape, and 16 mm and 35 mm film. Illustrated are typical units: a binaural head for 1/4 in. tape, a 4-channel Cinemacscope motion picture head, a 7-channel head for 5/8 in. tape, and a 14-channel, interlace head for 1 in. tape.

The construction of these heads assures complete and simple interchangeability. The elimination of any potting compound at the head surface prevents oxide buildup, and the use of a laminated core consisting of strips of a special alloy 0.0002 in. thick results in high efficiency and the ability to withstand wide temperature variations, vibration, and shock.

All heads are subject to a wide variety of modifications to suit the individual needs of the customer, such as low and high impedance, and bit density capacity for digital use.

J. B. Rea Co., Dept. ED, 1723 Cloverfield Blvd., Santa Monica, Calif.

CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION

Effective new shielded room requires no maintenance

Filtron, Inc.—electronic components manufacturer—selected Armoply panels for a shielded room that's easy to assemble, move, or alter in shape with ordinary labor. Special compression joints end need for soldering in this room, erected by Shielding, Inc. And Armoply requires no maintenance; gives effective shielding and a neat appearance for decades. (Armoply available with copper, lead, aluminum or other metal faces.) For full information and a free Armoply sample, write:

Weldwood® Armoply®
UNITED STATES PLYWOOD CORPORATION
Dept. ED9-15-56, 55 West 44th St., New York 36, N. Y.

CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION

New booklet* describes latest uses for Straits Tin in major industries

New booklet contains up-to-the-minute information about one of our most useful metals—Straits Tin from Malaya. Explains how tin's properties help each major industry, gives specific examples of new applications solving manufacturing problems. Sixteen pages, fully illustrated, factual and concise.

*Prepared especially for busy executives, materials selectors, design and production engineers. Your copy awaits your request.

The Malayan Tin Bureau
Dept. 121, 1028 Connecticut Avenue
Washington 6, D.C.

Please send me a free copy of the new booklet, "STRAITS TIN FROM MALAYA, Its New Importance to American Industry."

Name and Position__________________________
Company__________________________
Street__________________________
City__________________________Zone State

CIRCLE 213 ON READER-SERVICE CARD FOR MORE INFORMATION
**GAMBLE?**

Sure... if the odds are in YOUR favor...

DECISION/INC—nationwide specialists in recruitment of engineering personnel—have an active and enviable record in developing job opportunities for men who want bigger salaries and a chance for greater personal achievement.

DECISION/INC is retained by more top-ranking firms throughout the nation than any other organization to find the right man for each job. This confidential service costs you nothing.

It takes TIME—MONEY—EFFORT to improve your job situation. If you are an engineer or scientist, particularly in the ELECTRONIC—AERO-NAUTICAL or GUIDED-MISSILE field, DECISION/INC will do this quickly, effectively at no cost to you.

**NOW is the time for DECISION!**

All you do NOW is... send us your name, address, job interest or title. We take it from there.

Write or phone:

OLIVER P. BARDES,
President—

DECISION/INC

1-8 FIRST NATIONAL
BANK BUILDING
CINCINNATI 2, OHIO

Garfield 1-7100

Publishers of the authoritative Engineers' Job Directory

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

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**Counter Timer**

**Makes Many Measurements**

The Model 226A Universal Counter Timer is a multi-purpose portable instrument designed for precise measurements or frequency, frequency ratio, period (1/period), and time interval. Pressure, velocity, acceleration, displacement, flow, rpms, etc., may be measured with suitable transducers. It may also be used as a secondary frequency standard.

Features include: simplified color coded controls and direct read-out in kc, mc, sec, or ms, with automatic decimal point indication; provision for oscilloscope marker signals for trigger level adjustment of start and stop points for time interval measurement of complex waveforms; and three independent continuously adjustable trigger level controls permitting full rated sensitivity at any voltage between ±500 v. Small increments of voltage which are ordinarily marked by attenuators are easily selected, even though high voltage bias levels, voltage steps, square waves, etc., are present.


CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION

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**New miniature disc cathodes...**

**... REDUCE HEAT, WEIGHT AND SIZE IN PORTABLE TV SETS**

They save up to 50% of required heater power, in contrast with most disc cathodes—hence, less heat inside the cabinet. 25% smaller size makes possible a shorter picture tube with a narrower neck... a smaller deflection yoke... and smaller overall cabinet size. If you are designing picture tubes for portable TV, and if you plan to use either 450 or 300 ma. heaters, get complete information on these new Superior ED-1-7 miniature disc cathodes. Write Superior Tube Company, 2050 Germantown Ave., Norristown, Pa.

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**Tachometer Has Pancake Design**

The Model 5 "Wac-Tac" provides a closely-coupled speed indicator to be used on integral horespower motors and automatic machinery. Its extremely thin "pancake" design provides a minimum of protrusion beyond the machine to which it is attached. It also provides a sturdy mounting means.

The unit delivers an ac voltage whose frequency and magnitude are linear with speed, making the design particularly useful for controls sensitive to either frequency or voltage. The generator sinusoidal voltage may be as high as 25 volts per 100 rpm, and the frequency is 30 cps per 100 rpm. No sliprings, brushes, or contacts are employed.

The model 5 is available for mounting within the frame of the motor or machine, or for external attachment. Other types and sizes are available.

Wac Engineering Co., Dept. ED, Dayton 2, Ohio.

CIRCLE 218 ON READER-SERVICE CARD FOR MORE INFORMATION

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**NEW TUBING CATALOG**

**...Covers small stainless, tubing and small tubular components**

Our new catalog is just off press, and a copy is yours for the asking. Contains up-to-the-minute data on Uniform's complete line of fine stainless tubing in aluminum alloys, copper alloys, nickel alloys, stainless and low carbon steel... OD's from .625 to .005 in.

Also covered in detail are such special products as pointer tubing, coil forms, and metal-shielded wire, as well as Uniform's complete forming and machining service. Write for your free copy today.

A complete stainless tubing service
Straight • Formed • Machined

**UNIFORM TUBES, INC.**

1200 Level Road, Collegeville 2, Pennsylvania

CHICAGO: 3539 N. Cicero

CIRCLE 219 ON READER-SERVICE CARD FOR MORE INFORMATION

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**General-purpose, Compact, Inexpensive Laboratory-type Unit Amplifier**

**Type 1206-B Unit Amplifier: $85.00**

3 Watts Output at Audio and Ultrasonic Frequencies

Harmonic Distortion less than 1% with 2 watts into 600 ohms from 20 c to 40 kc.

Power Output is 3 watts from 10 c to 50 kc; 1.5 watts 5 c to 100 kc and 0.5 watt at 250 kc, with 300 volt plate supply, 600 ohm load.

CIRCLE 220 ON READER-SERVICE CARD FOR MORE INFORMATION

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**General Radio Company**

275 Massachusetts Ave, Cambridge 39, Massachusetts, U.S.A.

90 West Street NEW YORK 6 + 8055 13th St, Silver Spring, Md. WASHINGTON 8, D.C.

1150 York Blvd., Westing, N.J. PHILADELPHIA

920 S. Michigan Ave, CHICAGO 5 + 1000 N. Seward St, LOS ANGELES 38

CIRCLE 221 ON READER-SERVICE CARD FOR MORE INFORMATION
Digital Voltmeter
Has 0.1 mv Sensitivity

This four-digit, ac-dc digital voltmeter automatically measures ac voltage with 0.1 mv sensitivity. Reading time averages 2 sec on ac, and 1 sec on dc. Readings are made automatically and presented on 1 in. high numerals.

Range of the instrument is 0.001 to 999.0 v dc and 0.0001 to 999.9 v ac. Range switching is manual on ac but automatic on dc. The ac accuracy is 0.1% of full scale; dc accuracy is ±1 digit. Frequency response is 30-10,000 cps at 10 megohms, 20 mmfd. The response curve is flat over the full range. Stability is 0.01% from 40 to 120 F, with automatic dc calibration. Ac calibration, set at the factory, can be adjusted to correct for long-term drifts.

The instrument is designed for mounting in a standard 19 in. rack. Panel height is 14 in. Where space is limited, the read-outs and controls may be miniaturized to 1-3/4 in. panel for rack mounting with 1/2 in. high numeral display. The instrument may also be modified to operate all types of printers.

Electro Instruments, Inc., Dept. ED, 3794 Rosecrans St., San Diego, Calif.

Brew Delay Lines

Distributed Constant
Lumped Constant
Ultrasonic

Here are some reasons why you can be sure your requirements will be fully satisfied when you come to Brew for delay lines:

- custom built to your specifications
- wide experience in all type lines
- advanced packaging techniques
- special manufacturing and testing procedures
- modern facilities and skilled personnel
- exacting quality control
- continuous research and development program

Send us your specifications or send for Catalog 54 giving the complete Brew story.

Richard D. Brew and Company, Inc.
Concord, New Hampshire

Miniature Connectors
Withstand High Heat, Altitude

These miniature, high altitude, high temperature connectors are capable of operation at any altitude and temperature up to 400 F (continuous operation). Higher temperatures may be applied for short-lived systems. This line of connectors is rated at 250 v ac and 500 v dc. Tests have shown voltages of 3500 v ac are required to cause voltage breakdown at 125,000 ft.

Standard connectors are available in 1, 3, and 7-contact configuration. A 7-contact connector is in a housing of 7/16 in. dia. The connectors are designed to meet MIL-C-5015B.

Typical connector weight is 0.04 lb. Materials are beryllium copper, aluminum, and teflon. There are no resonances through 2000 cps.

R. A. Castell & Co., Dept. ED, 740 Salem St., Glendale 3, Calif.
Coaxial Constant Mismatch
DC to 4500 mc

Model RDL-2 Coaxial Constant Mismatch is featured in a new line of coaxial precision terminations and attenuators, operating from dc to 4500 mc.

The Mismatch is produced in VSWR's of 1.25, 1.5, 2.0 and 2.5.

The use of evaporated metal resistors throughout and of sealed construction make the units suitable for field, as well as laboratory use.

Radar Design Corp., Dept. ED, 210 Fifth Ave., New York 16, N. Y.

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION

Six-Decade, Event Timer
JAN Approved Components

Model 2100, a 6-decade, digital timer is a compact and accurate instrument having a resolution of 1 ms and a maximum indication of 999.999 sec. The timing frequency is directly obtained from a 1000 cps tuning-fork oscillator whose accuracy is 0.001 per cent from 0 to 75 C. Specifications: start and stop trigger input: 10 to 100 v common or separate; power: 117 ±12 v, 60 cps, 25 w; size: 19 x 3-1/2, 7 in. deep; weight: 16 lbs.

Hupp Instrumentation, Dept. ED, 2119 Sepulveda Blvd., Los Angeles, Calif.

CIRCLE 232 ON READER-SERVICE CARD FOR MORE INFORMATION

Squeeze Gun
Provides Fine Graphite Spray

This container and gun sprays graphite with a squeeze of the fingers. It is small enough to hold in the hand and sprays dry lubricant at its target while held in any position.

Enough graphite is contained in the unit to permit several thousand “shots” of lubrication to parts and pieces needing lubrication. A rubber “squeeze-type” bulb is attached to the container to provide a fine graphite spray that is easily directed to the target without squirting or clogging. The gun is offered at very low cost.

Servwell Products Co., Dept. ED, Cleveland 3, Ohio.

CIRCLE 233 ON READER-SERVICE CARD FOR MORE INFORMATION
Power Supply
Magnetic Amplifier

Model 32V15A, a new magnetic amplifier type, has low voltage-high current power supply, has a closely regulated tolerance at 15 amp; output is continuously variable from 5 to 32 v without switching. Regulation is rated at ±1% from no load to full load, and ±1% from 105 to 125 v input. Output ripple voltage is not over 1 per cent rms @ 32 v and full load, and not over 2 per cent @ 5 v and full load.

Oregon Electronics, Dept. ED, Portland 15, Ore.

Mobile Recording System
8-Channel Oscillograph

Space-saving compactness and mobility are two features of a new 8-channel oscillographic recording system. Completely self-contained, the Model 158-5490 system is designed primarily for recording analog computer outputs, but may also be used for other types of recording. Over-all, the new system measures only 46-1/2 in. high, 27 in. deep and 22 in. wide. All amplifier and recorder controls are mounted on top of the cabinet. Push-pull single-ended input signals are fed into miniaturized, dual-channel dc amplifiers of current feedback design. System features include 0.1 v/cm sensitivity; overall linearity of 0.25 mm over entire 4 cm of chart; drift less than 0.5 mm per hour; 5 meg input impedance (each lead to ground); flat frequency response to 20 cps, down 2 db at 60 cps for all amplitudes 4 cm peak-to-peak; nine chart speeds from 0.25 mm/sec to 100 mm/sec; true rectangular coordinate recording.

Data Recording Camera
No Double Exposures

Designed for technical, industrial, and scientific photographic data recording, an improved model of the Beattie Varitron Model E camera offers efficiency and reliability. The Beattie Varitron Model E has several new outstanding features: A positive interlock to prevent double exposure regardless of how long the exposure button or mechanism is held, and a new control for even exposure of supplementary data on the negative.

Film magazines for the Varitron Model E accept both daylight and darkroom loading spools of 35 mm and 70 mm film. However, all previous Varitron film magazines may still be used for this new model. An instantaneous shutter and a time exposure shutter both are readily interchangeable and only require plugging into the electrical circuit of the camera. Old style shutters are not interchangeable with these latest type shutters. In addition, the Varitron Model E is now available in 28-v dc.

Photographic Products Inc., Dept. ED, 100 N. Olive St., Anaheim, Calif.

Magnetic Field Measurement
Extremely Sensitive

The Magnatest FM-200 Precision Magnetic Field Meter is an extremely precise instrument for measuring static dc magnetic fields as small as 0.01 millioersted with an accuracy of ±1% of the scale reading. With ten ranges, from 1 to 1000 millioersted full scale, the FM-200 is equipped with several different types of probes which expand its usefulness to many applications including both absolute and differential measurements. When used with a recording instrument, the speed of response is on the order of 0.001 second. The new Magnatest Coercive Force Meter (FM-300) has similar characteristics.

Magnafux Corp., Dept. ED, 7300 W. Lawrence Ave., Chicago 31, Ill.

New Beryllium Copper ROLLPIN

Now . . . extend the proved advantages of Rollpin to a wide variety of applications where resistance to corrosion, good electrical properties and nonsparking or nonmagnetic characteristics are required.

Use it as you use carbon steel Rollpins—to replace taper pins, straight pins and set screws; to serve as a rivet, dowel, hinge pin or stop pin—to cut production costs by eliminating special machining, tapping, and the need for hole reaming or precision tolerances. Driven into a hole drilled to normal production standards, Rollpin locks securely in place, yet can be readily drifted out and reused whenever necessary. Beryllium Copper Rollpins are available from .062"-diameter to .250".

For all the information you need, write Elastic Stop Nut Corporation of America, 2530 Vauxhall Road, Union, New Jersey, Dept. R36-957.
The "Monitron" is for testing electronic equipment where the output signal does not energize a sound producing indicator. It provides a means for sounding an alarm (audio tone) in case of a break in the signal path, thus enabling the monitoring of signal paths without requiring the constant attention of a technician. At the same time, a dual electron ray indicator tube continues to monitor the signal level independently of the alarm circuits, and an indicator lamp also lights in the channel under test in which the failure occurs.

The "Monitron" can be used to trace signals and localize intermittent problems on any steady signal carrying circuit, whether it be a receiver, transmitter, or similar device. Four major ways to employ the instrument include: monitoring a circuit without attention; monitoring two different circuits simultaneously, tracing signal paths; and making point-to-point gain measurements.

Seco Manufacturing Co., Dept. ED, 5015 Penn Ave. South, Minneapolis, Minn.

**NEW AMPLIFIER SAVES SPACE**

A new plug-in d.c. amplifier section offered by Brush permits more compact, flexible, multi-channel recording systems. Six complete interchangeable amplifier sections, plus power supply, plus six-channel oscillograph now can be mounted in a table-top console only 29½ inches high. The amplifier features a unique internal calibration system, and has frequency response from d.c. to 100 cycles.

**PRINTED CIRCUITS**
can simplify your design . . .  
speed output . . . cut costs

Eliminate wires! With Du Pont Conductive Coatings, you can print circuits for capacitors and couplings; for static shielding to replace foils and cans; for resistors and solder seals. Streamline your designs in television sets and radios, electronic equipment, meters and switchboards.

Coatings are easily applied by spray, brush, dip or stencil on metals or non-conductors. Fits right into high-speed assembly-line operation. Save you money. For up-to-date, descriptive bulletin write to: E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

**DU PONT**

**CONDUCTIVE COATINGS**
—Best for printed circuits!

**SCHEDULE A**
**PRODUCTION RUN OF ANACONDA®**

**QUALITY-CONTROLLED MAGNET WIRE**

This technician and her co-workers check the quality of all raw materials received at Anaconda mills. Only after they are sure that Anaconda's rigid raw materials specifications are met is the material released for production.

This same rigid control is exercised over Anaconda Magnet Wire throughout its entire manufacture—even into shipping.

The result is the finest magnet wire on the market today. A production run will show you how this insistent demand for quality pays off in your winding room—in fewer rejects, longer break-free runs. Many customers are able to eliminate incoming inspection, too.


**Centrifugal Blower**

60 CFM Air Delivery

This centrifugal blower is designed to meet the latest demands for cooling electronic components where higher back pressures have become a problem.

The blower itself resembles the Standard No. 2-1/2 blower with maximum dimensions of 3-7/8 by 4-3/8 in. It can be furnished with motors built to applicable government specifications operating from 115 v, single or 3-phase, 60 or 400 cy, and 24 v d-c. Typical air delivery is 60 CFM against 4" S.P., when driven by a 4-pole cycle motor at 11,000 rpm.


**Magnetic Switch**

Eyes Assembly-Line

A "magnetic detective," to locate objects containing iron on assembly lines, in liquids and even the moving parts of automatic machine tools, has no moving parts. Detection is accomplished by the object's passing through a magnetic field set up directly in front of the switch's sensing end.

In assembly-line operations, the switches program the operations as the metal part moves from one station to another. Any break in the sequence is immediately detected and generally shuts down the line until the cause can be determined and corrected.

The new switch, 6 in. long and 1-5/8 in. sq, is sheathed in a heavy steel housing. The magnetic circuitry is embedded in a solid plastic solution. The switch sensing poles are designed to detect metal objects within 1/8 in. of its face. In the case of machine tool operation, the new switch cannot be set off by falling metal chips. It operates on 60 cy, 115 v ac.

Plug-in Kits

Take a Variety of Assemblies

These flexible assembly kits provide readily wired packages utilizing "Lip-Loc" cases and "Deck-Turrets" which may be arranged to mount various circuit assemblies.

For example, Kit 4-EK3, with its accessories, may be set up to mount one to three miniature sockets (either 7 or 9-pin) in any order, using adapter rings to accommodate different socket diameters. Socket holes are 3/4 in. diam with slots for saddle screws. 7 or 9-pin sockets are supplied, and also an equal number of JAN type shield bases of each type. Plug buttons are supplied to close socket holes where tubes are not required. An extra undrilled base is supplied so that larger plugs, such as the "Blue-Line" may be mounted. This kit is assembled with two decks with "Zip" terminals, 9-pin sockets, and an 11-pin octal type plug-in case. One extra third deck is supplied as a loose part which may be inserted in the stack if desired. Overall height of 3, 4, and 5 socket plug-in units is 3 in.

Vector Electronics Co., Dept. ED, 3352 San Fernando Rd., Los Angeles 65, Calif.

CIRCLE 262 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Silicon Rectifiers

High Temperature Application

Designated the "TJ-A" miniature rectifier series, these hermetically sealed miniature silicon rectifiers have peak inverse voltage ratings from 50 to 400 V. They have maximum forward current ratings of 200 mA at 150°C. The lead-mounted construction enables easy printed board or terminal board mounting.

Two type TJ-40A miniature rectifiers in a full-wave center tapped circuit, with capacitor input filter, can deliver 200-v dc at up to 400 ma continuously at 150°C ambient temperature.

Transistor Electronic Corp., Dept. ED, Melrose 76 Mass.

CIRCLE 263 ON READER-SERVICE CARD FOR MORE INFORMATION
New Literature

Mechanical Tubing 270
A data sheet has been issued on tolerance tables and additional size ranges for square, rectangular and round carbon and stainless steel welded mechanical tubing.

Wall, desk and pocket type charts list the tube, wall and cut length tolerances for hot and cold rolled carbon and stainless steel tubes, in addition to weight and chemical analyses.

Specifications are in tabular form mounted charts.
Steel and Tubes Div., Republic Steel, 224 E. 131st St., Cleveland 8, Ohio.

Free Analog To Digital Conversion Chart 268
This chart demonstrates the dual-brush logic used to obtain a truly non-ambiguous, natural binary analog-to-digital converter. The brush and disc patterns are those of the ADC-BNRY series of Analog-to-Digital converters manufactured by Norden-Ketay Corp., 99 Park Ave., New York, N. Y.

Designed by Ken Bacon of the Digital Engineering Staff, Instrument and Systems Div., requests will be honored for a free copy of this circular slide chart.

Perforated Metals 269
A new 6-page brochure has been made available describing a line of industrial and decorative perforated metal sheets. Included are information as to sheet sizes, type and gage of metal, and percent of open area. Perforated patterns are illustrated at actual size.
The Harrington & King Perforating Co., Inc., 5655 Fillmore St., Chicago, Ill.

Rectifiers 271
A selection chart, ETD-1322, has been released listing the essential characteristics of 75 power rectifiers and control tubes available. The chart classifies 46 thyatrons according to type, lists anode and cathode current and voltage ratings, and gives the average control characteristics of each tube. Twenty-nine ignitrons are listed according to classification; welding-control tubes, frequency-changer welding tubes and power rectifier tubes.

General Electric Tube Sales, 1 River Rd., Schenectady, N. Y.

Laminated Sheets 272
Recently published is a 12-page, 2-color catalog containing information on the manufacture of laminated sheet, wire and tubing for industrial use. Comparative tables of weight and other technical information are in the catalog.
The Improved Seamless Wire Co., 775 Eddy St., Providence, R. I.
Transmitting Materials

A 4-page bulletin is available covering transmitting materials suitable for use as optical elements. Transmission curves are included for the eleven most important materials. A key factor in the design of infrared equipment is the bandwidth of infrared transmission accepted by the transducer components. Since optical elements are generally critical portions of the infrared system, they must transmit infrared in the proper bandwidth as well as meeting other chemical, physical and mechanical requirements.

Servo Corp. of America, New Hyde Park, N. Y.

Metal Atenate Process

A 5-page bulletin has been released describing a new process for producing permanent jet black markings on stainless steel. The bulletin gives resistance qualities, material, color, and other information of interest to engineers.

Photo Chemical Products, 470 Walton Ave., New York, N. Y.

Power Supply

A new bulletin has been made available describing Model M562 strain gage power supply, 5 v at 1 amp continuous. The bulletin features specifications and applications, as well as an outline dimensional drawing of the unit.

Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

Services and Facilities

A 72-page bulletin covering services and facilities has recently been published. This bulletin contains more than 70 photographs and covers typical measurements and determinations made on hundreds of products and materials. In addition, it catalogs laboratory equipment available for limitless assignments in the fields of testing, applied research, and engineering analysis. This information is subdivided into the areas of chemical, electrical, electronic, mechanical and physical, and photometric, radiometric, and colorimetric testing.

Electrical Testing Labs., Inc., 2 E. End Ave., New York 21, N. Y.

Introducing...

the New Look in Laminated TUBING

fiberglass-epoxy tubing

Especially designed to solve ever-increasing insulation and other problems for the electronics industry, TUFF-TUBE combines all the desirable features of fiberglass-epoxy with the exclusive new Lamtex impregnation and curing process.

TUFF-TUBE can help you in dozens of applications calling for any combination of critical requirements: electrical properties, high temperatures, dimensional stability, low moisture absorption, corrosion resistance, light weight, strength.

- WAVESGUIDES
- COIL FORMS
- COMPONENT JACKETS
- CHASSIS FORMS
- Uniform thin walls, down to .006"
- All shapes and sizes, down to .062" OD
- Also copper-clad for precision printed circuits

LAMTEX INDUSTRIES, INC. * DEPT. D * 51 STATE ST., WESTBURY, N. Y.

CIRCLE 281 ON READER-SERVICE CARD FOR MORE INFORMATION

More and more people are turning to us for electroplated wire. We electroplate by continuous methods a wide variety of wire in a range of diameters from .035" to the smallest available. In our laboratory, Tungsten wire as small as .00015" has been electroplated with Gold... New applications for electroplated wires on different base materials are being developed from time to time...

Your inquiry is invited. Consult our staff, without obligation, about your specific wire problems.

Sigmund Cohn Mfg. Co., Inc.
121 S. Columbus Ave., Mount Vernon, N. Y.

CIRCLE 282 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 280 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN * September 15, 1956
Self-Locking Fasteners 287
Catalog No. 11-B, 12-pages, has been issued showing the complete line of self-locking fasteners. Based on the use of a nylon pellet inserted into the threaded area of fasteners, the pellet locks in any position along the thread, and when removed, the "plastic memory" of nylon makes it return to its original shape, providing great reusability.

In addition to the standard parts listed, parts may be made to special design.
Nyloktm Corporation, E. 14th and Grand Central Ave., Elmhurst Heights, N. Y.

Thermostat Bimetal 288
A 6-page illustrated data sheet containing complete engineering data on a new thermostat bimetal, ASC-3, is now available.

The data sheet, designated Technical Data Sheet No. A-401, contains, in addition to engineering specifications, formulas for thermal deflections, load of force, force-temperature, force-deflection and stress of cantilever, U-shape, and helical elements. Industrial Division, American Silver Co., 36-07 Prince St., Flushing 54, N. Y.

Subminiature Relay 289
A two-page bulletin, GEA-6412, has been issued describing the 2PDT hermetically-sealed subminiature relay. The two-color publication describes the addition to the company's line of hermetically-sealed relays; and lists the relay's operating advantages. The bulletin also provides a table of technical data on the operating characteristics of the relay along with a table of coil data which lists coil voltage, coil resistance, etc.

General Electric Co., Schenectady 5, N. Y.

Laminated Tubing 290
A 4-page illustrated brochure describing TUFF-TUBE, new laminated fiberglass-epoxy tubing possessing properties is now available. This brochure contains information on high temperature characteristics, electrical properties, weight and strength. Also included is an illustrated section dealing with suggested applications of this material, of interest to designers in the aircraft, electronics, chemical, petroleum, and food industries.

Lamtex Industries, Inc., 51 State St., Westbury, L. I., N. Y.

SAVE space, time and MONEY-

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Newest in the line of EDCOR adjustable and fixed Polystyrene Decades is the 1 to 10 mfd PS model.
The EDCOR PS Decades maintain high insulation of 100 meg/mfd, precision up to .1%, long-time stability and the space-saving benefits of precision capacitors combined into a single package. EDCOR PS Decades are widely used in Analog Computers, Filter Designs, Laboratory Standards.

For Engineering information and consultation write:
U. S. ELECTRONICS DEVELOPMENT CORP.
1323 AIRWAY • GLENDALE 1, CALIF.
Filters • Networks • Comparison Bridges • Decade Boxes • Servo-circuits

CIRCLE 291 ON READER-SERVICE CARD FOR MORE INFORMATION
Ultra-Thin Copper

The ASC Technical Data Sheet TWC-101 is now available describing wrought ETP copper, rolled to record thickness of as low as 0.00017 in. This was produced to meet Air Force requirements for material of superior electrical conductivity properties that would operate at high temperature, occupy appreciably less space, and weigh appreciably less than conventional copper wire. It discusses the advantages of ultrathin copper tape over aluminum for wafer-coil applications.

American Silver Co., Inc., 3607 Prince St., Flushing, N. Y.

Deflection Yokes

A revised catalog-page has been released describing magnetic deflection yokes for 11-1/2 in. neck diameter military and oscilloscope applications. Complete data includes design features, dimensional drawing, and revised tables listing electrical and mechanical characteristics, push-pull deflection coil data and single-ended deflection coil data.

Syntronic Instruments, Inc., 170 Industrial Rd., Addison, Ill.

There is no one "cure all" for system instability. The desired stability of a servo loop is attained through the proper selection of components that satisfy the various conditions under which the loop will operate. Kearfott offers four basic motors and combinations for providing system stability. All feature high speed of response; low inertia and high stall torque.

SERVO MOTORS: Servo motors with high torque to inertia characteristics possessing (built-in) inherent damping ranging in size from % to 1% diameter are available. Low speed, low power motors for use in simple instrument servos where high damping and/or low time constant is required can also be provided.

VISCOUS DAMPED SERVO MOTORS: Provide integral viscous damping for simple instrument servos. Any degree of damping can be provided. These units reduce no load speed of standard motors to 50% or 75% of normal, providing 70% or 50% of critical damping respectively.

INERTIAL DAMPED MOTORS: Integral inertially damped motors for use in high-speed and/or high gain servo systems—damping on acceleration or deceleration basis with little loss in normal no load speed. These units make possible system cut off frequencies up to 25 cps using magnetic amplifiers.

SERVO MOTOR TACHOMETER GENERATORS: For system stabilization by voltage feedback from an integral tachometer generator. May be obtained as damping generators for use in simple rate servos or as rate damping generators for use in very high gain systems. The latter feature high linearity, high output and maximum output to fundamental null ratios.

These servo motors are suitable for most exacting requirements. Write today for descriptive bulletin giving data of components of interest to you.
“from rogues to rockets”...

Benjamin Thompson, Count Rumford — 1783-1814... rogue extraordinary... traitor... turncoat... yet one of the greatest scientist of his time. Founder of the modern science of ballistics, his theories and work on early artillery were the basis of Napoleon's concept of highly mobile artillery units. But starting in 1806, Congreve's rockets with their greater range and power almost replaced artillery... until it was found that rifling the barrel of the big guns gave the needed distance and accuracy. Gradually the rocket took a back seat as a war weapon until it was revived during World War II.

These early weapons contrast against today's intricate weapon systems, as the present products will compare with the even more complex needs of tomorrow. But at Bell Aircraft these complex needs are already well in the planning stage. Highly trained engineering teams are dealing not only with today's problems, but tomorrow's achievements. For the creative engineer seeking top assignments, Bell can offer opportunities leading to a high level of professional achievement — in an engineering department with that young look.

Engineers with experience in the design and development of electronic components including:

- Integrators
- Computers
- Accelerometers
- Transmitters
- Receivers
- Amplifiers
- Antennas

Please contact...

Manager, Engineering Personnel

Spot Welder

Bulletin 339, completely describing a four function spot welder covering a wide range of aircraft and other rigid welding specifications, has been introduced. This bulletin discusses the various circuits employed with this new type dekatron tube control. Various illustrations and a block diagram, and the four function spot welder is simply and effectively explained.

Included are the various possible combinations of control function for spot and seam welders.

Sciaky Bros., Inc., 4915 W. 67th St., Chicago, Ill.

Molded Plastics

A 17-page bulletin has recently been issued describing molded plastics. Some of the methods of molding, including compression, injection, cold molding and molding of reinforced plastics are discussed in this 3-color illustrated booklet. In addition the booklet contains photographs of various molding operations and descriptive explanations of applications.


Variable Transformers

A 22-page catalog, No. A56, has been issued describing the expanded and redesigned line of adjust-A-volt variable transformers in auto, isolated and metered models for bench and panel mounting. All single and ganged units are illustrated and described with photographs, dimension drawings, wiring and circuit diagrams.

A complete specification and application index is also included.

Standard Electrical Products Co., 2240 E. Third St., Dayton, Ohio.

Selenium Contact Protectors

Bulletin “A-B-C” on selenium contact protectors, which explains the operation, uses and advantages of this product, has recently been issued. The bulletin is for use by design engineers and components distributors wanting to know about the selenium protectors which are used to eliminate arcing between contacts in inductive circuits.

Components Div., Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.

Century MODEL 20 VISUAL MONITOR

For TEMPERATURE PRESSURE VIBRATION FLOW RADIATION COLORIMETRY CURRENT VOLTAGE

Does your data problem include any of the above? Or anything similar?
The Model 20 Visual Monitor is a completely new concept in multiple data-point indication.
Now you can observe and measure 24 separate data points, simultaneously. No Switching, no commuting, no time lag.
Wherever a graphic display of several quantities will facilitate measurement and control, the Model 20 should be considered.
Utilizing light-beam D’Arsonval galvanometers as the indicating elements, the Visual Monitor permits display of transducer output in an easy-to-interpret, graphic form.
Let us hear from you. We would like to discuss your instrumentation problems with you.

Century Electronics & Instruments, Inc.
1333 No. Utica, Tulsa, Oklahoma
CIRCLE 311 ON READER-SERVICE CARD FOR MORE INFORMATION
Microminiature Relay

An eight-page bulletin, GEA-6346A, has been published describing hermetically-sealed microminiature relay. The two-color publication provides a detailed description of the lightweight relay for airborne, shipboard, and portable unit applications. Operating features are listed and discussed individually, and a complete table of specifications is included. Photographs of the various types of microminiature relays; coil data table for each model; and technical data on the types of cans and mountings are included.

General Electric Co., Schenectady 5, N. Y.

Switches

A 4-page bulletin has been released describing the propeller feathering system switches, turbo-jet engine starting system switches and generator and inverter circuit switches. The bulletin shows illustrations, technical descriptions and wiring diagrams. Also included are time delay units and torque pressure switches.


Potting Shells

A data sheet on potting shells for several types of its electrical connectors has been announced. Sealing compound, applied in a molded plastic potting shell after wiring the connector contacts, provides complete protection of solder cups and wires. It seals the connector against moisture and prevents cable strain under extreme vibration and repeated connect and disconnect of plug and receptacle. The data sheet illustrates several shapes and sizes.

Electronic Sales Div., DeJur-AMSco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.

Assembly Components Kit

A 12-page brochure, TDS 1110, has been published describing Service Units. Three terminal assemblies provide compact termination and convenient test points for all "internal" wiring as well as take-off points for connection of "external" equipment. Two different dial assemblies are available to show the degree of rotation of a shaft.

Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, L. I., N. Y.
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The rapid scientific advance of our modern civilization is the result of new ideas from creative minds that are focused on the future. Our engineers not only have ideas but have the ability to engineer them into products.

That’s why The Garrett Corporation has grown in both size and reputation to leadership in its areas of operation. That’s why we are seeking more creative engineers to help us maintain and extend our leadership. If you fall in that category, you’ll find working with us fulfilling in stimulation, achievement and financial rewards.

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We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of your education and experience today to: Mr. G. D. Bradley

The Garrett Corporation

VACAP, 1905 Summit Ave., Union City, N. J.

Data Wall Chart 329
Engineering Data Wall Chart, giving tables on decimal equivalents, temperature conversion, wire size and current ratings, mechanical and electrical conversion tables is now available.
Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

Soldering Equipment 327
Five illustrated literature sheets have been issued describing soldering equipment. Complete specifications and servicing information are given and the tools are shown in operating position; the Versa-Tool is also shown open for servicing.

Vacuum Capacitors 328
A new specification sheet on high rated variable vacuum capacitors is available. This features rugged construction using glass bulbs, copper seals and cylinders. Included are line drawings and application notes.
VACAP, 1905 Summit Ave., Union City, N. J.

Wafer-type Coils 331
A data sheet, published on ultra-thin copper for the new wafer-type coils, is now available to electronic and electrical engineers. This data sheet, designated as ASC Technical Data Sheet TWC-101, gives detailed information on mill limits, chemical composition, hardness requirements, and availability. It discusses the advantages of ultra-thin copper tape over aluminum for wafer-coil applications, and gives complete information on how to specify and order this material.
American Silver Co., 36-07 Prince St, Flushing 54, N. Y.

Phone Plugs and Jacks 330
The S-57, 28-page catalog has been issued giving detailed information on new products and the company’s expanded line. This booklet includes specifications, drawings, schematic circuits and prices on component parts. Products include jacks, plugs, switches, connectors, shielded jacks, cable assemblies, jack covers, and several other component parts.
Switchcraft, Inc., 1329 N. Halsted St., Chicago 22, Ill.

Electronic Design 98

100 WATTS . . . from 28v DC input
. . . from 115v, 400 cps AC input

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100 WATT DC-DC: 3" x 3" x 6", 3 lbs.
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Efficiency to 90%, or more Regulated or unregulated. Rugged to meet military specifications

UAC offers a complete range of compact power supplies: 1, 5, 10, 25, 50, 75, 100 Watts (500 Watts for special uses) ... DC to DC ... AC to DC ... DC to AC for use in intercoms, radiosonde, telemeters, or wherever highly efficient portable power is required.

Write, wire, phone specifications today on your current production. Also ask for information about UAC transistorized radiation detection instruments.

Universal Atomics Corp.

CIRCLE 332 ON READER-SERVICE CARD FOR MORE INFORMATION
Coil Winder 336
A data sheet on the toroid coil winder has recently become available. It describes the method of winding off the inside of the shuttle that makes possible the winding of finished coils having an inside diameter of 3/32 of an inch.
It also contains full specifications of the wide range of wire sizes possible; the full 360° coverage of the core; the high 200 turns per minute winding speeds.
Electro Devices Co., Inc., 580 Main St., Wilmington, Mass.

2-Ounce Molding Machine 337
Bulletin 565, recently issued, features the Model 701 2-ounce automatic injection molding machine. Bulletin gives complete specifications for Model 701, and also describes the advisory service for plastics molders which provides them with a detailed cost study on their specific product and enables them to find out what truly automatic injection molding can do for the machines.

Development in Infrared 338
Bulletin No. 18 has been issued featuring articles on the subjects of infrared spectroscopy and data processing. The new Beckman "111" data system with its accuracy, versatility and reliability along with "pinboard control" is described. Included is a two-page spread complete with charts and pictures of 10 additional uses for the DK recording Spectrophotometers.

Packaging Booklet 339
A booklet has been published describing the applications and money saving aspects of the company's Cutter and Crimper. Illustrations are included for the many uses of pre-cut and crimped material, and how they are being employed by various wrapping departments. The booklet describes the operation of the cutter and crimper and pictures a suggested floor plan and packing table arrangement.
Kord-Mar Co., Inc., 204 Lockerbie, Wilmette, Ill.

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CIRCLE 346 ON READER-SERVICE CARD FOR MORE INFORMATION

Grounded Grid Radio Tube Circuits

In a circuit using a vacuum tube having a grounded grid and cathode resistor there is a transfer of the signal from cathode to anode which produces a diode effect. This diode effect is objectionable since it is out of phase with respect to the input signal at the grid and causes trouble in radio receiving circuits which use circuit elements for interference degeneration.

The circuit of Fig. 1 compensates for this diode effect and requires a multiple grid tube, a pentode I being particularly shown. The elimination of the diode effect is secured by using a condenser 17 between the control grid and ground and also by using a resistor 5 and shunting condenser 7 of a particular value or adjusted to a particular value in the input circuit. A portion of the input signal developed across the resistor 5 and condenser 7 is applied to the screen grid through condenser 9.

Initially the condenser 17 is connected between the control grid and the cathode and a signal is applied to the input term-
Rapid Response Self-Saturating Magnetic Amplifier


Magnetic amplifiers, using rectifying means in series with the load and load current control winding of the saturable reactor, experience a difference in the speed of response to signal and transient currents in opposite directions. A magnetic amplifier which does give a rapid response for these signal currents in both directions has advantages. This is particularly true of a full wave form of circuit. The slow response to signal currents in one direction is due to an inductive voltage generated in the load windings of the saturable reactor.

The circuit shown in the figure secures a rapid response to signals in both directions by providing a resistor 18 in series with the load winding 16 of the control saturable reactor. Across this resistor a voltage is provided 180° out-of-phase with the voltage in the load circuit by a portion 24 of the transformer secondary 19, or it may be a separate winding. In this shunt circuit there is a rectifier 25 so that current flow in the resistor 18 is in the same direction as load current flow in the load circuit.

With this circuit, when an induced voltage is generated in the load winding 16 of the reactor, an opposing potential is set up in the resistor 18 and thereby compensates for the induced voltage. The contact 26 may be adjustable to change the relative proportion of potential in the respective windings 19 and 24. The circuit illustrated is a half-wave circuit; however, the patent also describes full wave circuits.

Display Surface For Color Television Tube


A display screen for cathode-ray tubes for producing television images in color. The device employs a number of parallel linear conductors for establishing a system of electron lenses adjacent to the display screen. The display screen has a coating of three different phosphors, emissive on electron impact of light of three component colors additive to produce white light. The conductive strips are arranged in a repeating pattern with alternate strips being wider at the end portions than at the central portion, and the intervening strips being wider at the central portions than at the ends.

NEW CONCEPT ... ADVANCED DESIGN IN THERMAL TIME DELAY RELAYS

Designed for high performance and long life, the Curtiss-Wright "SNAPPER" Thermal Time Delay Relay is proving itself in countless applications involving time delay in electrical circuits. Such applications include circuits to provide definite on-off time intervals to delay the application of high voltage until after warm-up period and for over and under voltage protection with simultaneous fault indication.

These relays have single-pole double-throw contact action, high ambient temperature range, freedom from chatter and arcing, and are small in size. The "SNAPPER" thermal time delay relays are factory pre-set from 3 to 120 seconds. They are available in metal envelope, miniature (7 and 9 pin) or octal (8 pin) and in a glass envelope in 9 pin only.

Curtiss-Wright manufactures the High-Low "SNAPPER" Differential Thermostat with high precision characteristics. Write to Thermal Devices for complete data.

It's AEROVox for LOW VOLTAGE

ELECTROLYTIC CAPACITORS FOR TRANSISTOR APPLICATIONS

Transistorized assemblies demand miniaturized low-voltage electrolytic capacitors. In many cases, conventional electrolytics prove adequately small; in others, new designs have to be developed. Aerovox application engineering, always in step with electronic trends, now offers a wide choice of miniaturized electrolytic capacitors.

Type PR Special Capacitors ... metal-cased, resin-sealed, subminiature electrolytics offering extremely low electrical leakage and excellent shelf-life characteristics. Available in voltage ratings of 1 to 50 VDC, and standard operating temperature range of -20° to +65°C. Other ratings, temperature ranges and mechanical configurations available.

Type PWE Capacitors ... hermetically-sealed, miniature aluminum-foil electrolytics offering high capacitance at low voltages. Available for vertical mounting or with axial leads as illustrated, in standard voltages from 1 to 50 VDC and standard operating temperatures of -20° to +50°C. Exceptionally low leakage currents.

Type XXP Capacitors ... metal-cased, compression-sealed, subminiature electrolytics providing exceptional shelf-life and extremely low electrical leakage characteristics. Axial-lead style as illustrated. Standard voltage ratings of 1 to 50 VDC and standard temperature range from -20° to +65°C. Other ratings, temperature limits and designs available.

Write for complete details on these and other Aerovox Components.
in the received signal is the more frequent culprit in causing loss of synchronization of the local oscillator.

The circuit of the figure includes the local oscillator 39 which is adjusted to the proper frequency. The output of the oscillator is amplified by the amplifier 52. The output of the amplifier is coupled to the line sweep coils 21 through the transformer 63 to give a sawtooth wave in the sweep coils. Be

Wheeler's new epoxy resin cast electronic components...including inductors, transformers, and subminiature assemblies of tuned circuit elements...offer the following specific advantages:

- Extremely wide ambient and internal temperature tolerance.
- Exceptional mechanical and physical stability...freedom from cracking, deformation, chemical or physical changes, and deterioration under service conditions.
- Exceptional electrical properties without tendency to deteriorate.
- High resistance to humidity, chemicals and other contaminants.
- Flexible leads and/or terminals.
- Elimination of hermetically sealed cans.
- Elimination, in many cases, of mountings.
- Further steps in miniaturization.

Wheeler's equipment for the casting of epoxys complements already very complete engineering and production facilities in the field of custom transformers, coils, amplifiers and electronic assemblies for military and civilian service. Here is your logical source for both development assistance and experienced production.

The Wheeler

Insulated Wire Company, Inc.
Division of Sperry Rand Corporation
1131 East Aurora Street • Waterbury 20, Connecticut

CIRCLE 349 ON READER-SERVICE CARD FOR MORE INFORMATION
between the signal separator 18 and the oscillator is an automatic frequency control circuit including the control tube 23. The received line synchronization signal is applied to the control grid of the tube 23 and the output of the oscillator amplifier 52 is fed back through a connection 65, condenser 66 and resistor 67 to the control grid of the control tube. The received synch pulse and the feed back pulse are of the same width but of opposite polarity. Normally the control tube 23 is non-conducting and, therefore, any noise between the synch signals does not pass through to the oscillator.

When the local oscillator is in synchronization with the synch signal, the synch signal and the feedback signal are in phase and the two signals cancel each other, so the tube 23 remains non-conducting. If, however, the feedback signal and the synchronization signal are out-of-phase, then a signal is generated, including a negative pulse produced by the negative synch signal having a width corresponding with the extent of out-of-phase and a positive pulse having a width corresponding with the out-of-phase relation. These two pulses are spaced by the feedback pulse from the amplifier cancelling out the negative synch pulse in the interval when the two signals overlap. The control tube 23 is biased so that the positive pulse causes the control tube 23 to conduct. The width of the positive pulse is therefore determined by the extent of out-of-phase between the synch signal and the feedback signal. This width modulated signal is integrated by the condenser 37 and resistor 36 and applied to the control grid 33 of the oscillator. The frequency of the oscillator is determined by the amplitude of the pulse applied to its control grid so that the oscillator is brought into synchronism with the synchronizing signal.

**Transistor**


The patentee has discovered that a junction type transistor provided with a layer of electron multiplier material at the junction surface or surfaces secures an increased output from the transistor. Suitable electron multiplier materials are beryllium oxide and silver magnesium alloy. A further increase in output is secured when an electron multiplier material is provided at both junctions of a two junction type of transistor.
Patent Briefs

Color Television Tube Target Structure
(Assigned to Chromatic Television Lab., Inc., New York)

This patent is similar to 2,745,083, described above, except that the electron beam can be deflected in two dimensions. An electrode structure mounted adjacent and essentially parallel to the screen can be excited by a signal source and cause the beam to fall on the appropriate phosphor and produce the desired color.

Solid State Amplifier
(Assigned to Bell Telephone Laboratories, Inc., New York)

An element of material exhibiting a large Hall effect is biased with a dc electric field and inserted in a wave guide. The electromagnetic field associated with the signal travelling down the wave guide interacts with the applied dc field and produces a Hall effect field. This Hall effect field in turn adds to the electric field of the signal and thereby produces amplification.

Monatomic Semiconductor Devices
Patent No. 2,743,201. Ralph P. Johnson,
Playa Del Rey, Robert G. Shulman, and
Delbert M. Van Winkle. (Assigned to Hughes Aircraft Company)

A method of producing PN junction semiconductor devices. A first semiconductor specimen with a relatively smooth surface is placed in contact with a second semiconductor specimen with a relatively smooth surface. The specimens are then forced together under pressure and heated until the first and second specimens fuse with each other in the vicinity of the junction.

Electronic Time Constant System
(Assigned to the Foxboro Company, Foxboro, Mass.)

An electronic integrating circuit which utilizes a capacitor connected between the grid and the plate of a vacuum tube. The Miller effect increases the effective capacitance as seen by the input circuit and thus produces a much longer time constant than would be possible with the capacitor alone.

PRESSURE TRANSUCERS

featuring
Fairchild accuracy and reliability

The unit shown features two pressure-sensitive diaphragm elements which actuate two precision potentiometers through a dynamically-balanced, stable mechanical linkage. Variations of size, conformation and pressure ranges for measurement of differential, absolute or gauge pressures are also available. For complete information, write Fairchild Controls Corp., Components Division, 225 Park Avenue, Hicksville, L. I., N. Y.; West Coast: 6111 E. Washington Blvd., Los Angeles, Calif., Dept. 140-701.

New 2" and 3" pressure transducers introduce a new line of Fairchild controls, featuring all the characteristics of precision, reliability and quality that are identified with Fairchild potentiometers. Now, pressure transducers will be available to you in a wider range of resistances in either linear or functional, single or dual potentiometer output elements.
Magnetic Field Measuring Device

An apparatus for measuring the intensity of an unknown static magnetic field. The system utilizes two coaxial solenoids with a regulated dc applied to the outer solenoid and an ac signal applied to the inner solenoid. A sensing coil, wound on a thin molybdenum-Permalloy core sealed within a quartz tube, is placed in the center of the solenoids. When the known field produced by the outer coil just balances the unknown field, a voltage is induced in the sensing coil and the unknown field may be calculated.

Waveguide Delay Line

An ultra high frequency delay line for operation at high power. The delay line utilizes a rectangular wave guide with regularly spaced baffles that extend into the wave guide perpendicular to the sides of the guide. Each baffle consists of a thin plate attached to a circular rod; the rod serves to increase the loading capacitance and inductance and reduces the breakdown voltage at the free edges of the baffle.
The BRUSH Deviation Test Bridge streamlines repetitive testing of electrical products or components where resistance, inductance, or capacitance are to be measured. A large easy-to-read interchangeable scale indicates percentage deviation of impedance and phase angle deviation in radians of the test unit from a selected standard. Parts can be checked to meet desired quality levels at rates up to 4000 units per hour. The knee operated test jig shown will greatly simplify the test procedure. For complete information write Brush Electronics Company, Dept. J-99, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS DIVISION OF CLEVITE CORPORATION

Computers—Their Operation and Applications

This book discusses newest developments in the techniques and equipment of automatic computers. Basic elements of digital, analog, and miniature computers are explained together with computer reliability, advantages, limitations, and maintenance. Other features include checklists of computer characteristics, listings of books, periodicals, etc., illustrations, and a glossary of terms and expressions.

Proceedings—World Symposium on Applied Solar Energy
Stanford Research Institute, Menlo Park, Calif. 304 pages. Price: $5.00.

From October 31 through November 5, 1955, in Tucson, Arizona, two consecutive major meetings were held on applied solar energy. At this meeting 96 papers were presented, in parallel sessions, on the technical and scientific aspects of solar energy. This was followed by the World Symposium on Applied Solar Energy in Phoenix, Arizona.

These meetings marked one of the first objectives of the Association for Applied Solar Energy, and to hasten the utilization of the sun’s energy.

The meetings brought together 900 scientists who have engaged in solar-energy research, and also many representatives of industry, finance, government, and education whose interest, enthusiasm, and abilities are needed to bring solar-energy utilization into being.

The Solar Engineering Exhibit, held in conjunction with the Symposium, was attended by nearly 30,000 persons. On display, and photographed in this book are examples of solar devices which included many working models.

Papers presented at the Symposium are contained in this volume.

Reactor Shielding Design Manual

The information is presented in this book in the order a designer would have to accumulate it in developing a shield design. The book deals with such subjects as basic processes, determining allowable radiation levels, shielding the reactor core and the cooling system, shield engineering, the effect of irregularities in the shield, and the effect of geometry on radiation source. The influence of plant layout, structure, and maintenance upon design is taken into account.

The methods discussed form a basic approach rather than a mock-up approach and thus permit design of shields without expensive and time-consuming use of the reactor facilities in which full-scale shielding mock-ups can be made. This should lessen the time required for the design of power reactor shields.

The contributions of a number of workers are represented in the book, as the shielding procedures described were developed along somewhat different paths and at different sites. The book pulls together scattered theory and joins it with some previously scattered practical material and naval experience so as to make a composite whole.
The second edition of nuclear theory has been expanded and all topics brought up to date. Coverage reflects the extension of nuclear experiments to the energy range of hundreds of Mev.

Experimental ideas are discussed. A list of nuclear species is also included along with exchange and interaction currents, high-energy nucleon interactions, present status of theory of beta-decay, etc.

Common Sense in Research & Development Management

This volume presents an impartial, comprehensive report on methods used in industrial, university, and governmental research and development establishments.

This book discusses items such as organization for effective control, selection of personnel, professional development of the worker, etc. Included are illustrative charts.
Russian Translations

What The Russians are Writing

J. George Adashko

Radiotekhnika, No 2, 1956

Connection between the (van der Poll) Approximate Equations and Power Balance. S. I. Evtianov (11 pp, 4 figs.)

The method of approximate equations is used widely for the analysis of stationary and transient processes in self-excited harmonic oscillators. Approximate equations introduced to radio-engineering practice by van der Pol and also in a less developed form by Moller have been widely employed by Russian workers in the study of non-linear circuits. Russians particularly active are Mandel'shtam and Papaleksi, Krylov and Bogoliubov (whose book is available in an English translation), Kobzarev, Teodorchik, and Evtianov. This article uses the behavior of a self-excited oscillator to derive the simplified equations from the balance of active and reactive power in the circuit. The advantage of the method is that they can be obtained from simple physical concepts and do not require writing down the complete differential equations of the system.

Non-Linear Distortion in Multi-Channel Communication System Using Frequency Modulation. V. A. Smirnov (15 pp 4 figs.)

Employs standard spectral-analysis methods to discuss the non-linear distortion produced in microwave relay systems by multi-path propagation and to study non-linear distortion produced in waveguides that are not fully matched to the antenna or to the receiver. Refers to articles in the Bell System Technical Journal by Bennet-Curtis-Rice and Holbrook-Dixon.

On the Theory of the Exponential Line, B. P. Afanas'ev, (14 pp, 5 figs.)

The exponential line has been used by many writers as a particular example of a long line with variable distributed parameters. The exponential line also gives best results when used for impedance matching. This article develops equations for the amplitudes of the currents and voltages in the lossless exponential line that are quite analogous with the corresponding equations for a uniform line. This leads to an expression for the wave impedance of an exponential line and again makes the matching conditions analogous for both types of lines. The wave impedance in this case is a complex quantity, and this in turn leads to the concept of a reactive travelling wave.

Equations are also derived for the travelling-wave coefficient, for the reflection coefficient, for the input impedance, and for the distribution of amplitudes in certain specific cases of line loading.

Interaction between Signal and Noise in a Detector with Inertia, L. S. Gutkin (11 pp, 6 figs.)

An ordinary diode detector may show no inertia whatever for a useful signal yet may exhibit considerable inertia for noise, particularly if the noise spectrum is quite wide. The article gives a mathematical analysis of the simultaneous detection of signal and noise voltage by a linear inertia detector. The input impedance of the detector is determined and the results of detection of unmodulated and amplitude-modulated signals are given. The frequency spectrum and the effective value of the noise voltage at the detector output are calculated. The equations derived are compared with the corresponding relationships for the inertialess detector.


The selective properties of resonant systems are evaluated by comparing interference-spectrum oscillations with the relative power of the useful spectrum oscillations. A selectivity criterion is established and it is shown that the use of other criteria leads to erroneous deductions.
The Deflectron was described in this country by K. Schlesinger (Electronics, July 1952). Judging from the number of references cited, Strashkevich has published at least seven other papers on the subject, covering the focusing and deflecting properties of the device and its electron-optical behavior. This article gives a mathematical discussion of the potential distribution in a system shown in the figure.

Calculation of the Amplification Factor and of the Principal Characteristics of a Transistor Amplifier Stage. G. S. Tsykin (4 pp, 4 figs.)

It is shown that the equivalent circuit of a transistor can be reduced to the form usually used for the electron tube. Expressions are given for the parameters of the equivalent circuit for various transistor connections. Sample calculations are given for standard transistors, and a method is indicated for determining the frequency and phase characteristics of single-stage and multiple-stage transistor amplifiers. To be abstracted in ELECTRONIC DESIGN.

Concerning the Problem of the Relationship between the Observability of an Object and the number of "Illuminating" Pulses. G. I. Bystrov (3 pp)

A probability study giving the detection probability from the signal-to-noise ratio and the number of pulses transmitted to the object.

Geometric Derivation of Equation for Transmitting Ability of a Noisy Communication Channel employing a Special Receiver, A. M. Vasil'ev (3 pp)

The "special" receiver referred to separates from among all the received signals the particular one that differs from all the received signals by the amount of noise power. Probability theory is used in this article too.

Design of Linear "Pre-distorting" and Compensating Devices, V. M. Shtein (4 pp, 2 figs.)

The signal-to-noise ratio in a transimission system is sometimes improved by connecting a linear pre-distorting four-terminal network at the input of the channel, and connecting a linear four-terminal compensating network at the output of the channel. Figure shows such a system. The signal from a transmitter, with a power spectrum \( P(\omega) \) passes through the pre-distorting network, which has a transfer coefficient \( k(\omega) \), before entering the line. The correcting network has a transfer coefficient of \( 1/k(\omega) \). The noise source with spectrum \( N(\omega) \) is assumed connected to the line output. The article gives a method for calculating the two networks so as to produce either a maximum signal-to-noise ratio for a given value of signal power, or else determine the minimum signal power required to maintain a given signal-to-noise ratio.

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Field Testing of Electron Tubes

FIELD testing at forward echelons is concerned with preventative maintenance and equipment repair. As a part of these maintenance and repair measures, electron tube testing has as its principal aim the restoration of equipment to optimum operating condition.

However, for most effective evaluation, the parameters of an electron tube must be measured in conjunction with the specific circuitry connected with the application, and not, as in the conventional tester, under a set of fixed conditions in no way typical of the particular application.

Although there are many instances in which the correlation between a tube parameter and a circuit application has been established, those cases in which correlation does not exist are far more numerous, and are steadily increasing.

Fully adequate field testing of electron tubes for the maintenance and repair of equipment is now impossible, hence the inherent limitations of the available conventional testers are presented, together with recommendations that field users of tube testers be made aware of the significance of the data obtained.

From the viewpoint of testing, an electron tube may be considered either an entity in itself or as one element of a circuit.

In the production, storage, and issue of tubes, the specific circuitry in a given application is generally not considered; that is to say, the tube is considered as an entity in itself. The quality of any tube type for these purposes is defined by a specification in which certain control parameters are identified.

These control parameters concern not only such electrical characteristics as emission, transconductance, interelectrode capacitance, and the like; but also such mechanical aspects as envelope size, grid-wire spacing, tension and spacing, electrode dimensions and spacing, and so forth.

The measurement of electrical and mechanical characteristics provides data which, when compared to the specification requirement, allows a judgment to be reached in determining the acceptability of the tube.

Such a measurement of quality yields a very precise result, eliminating any ambiguity that might otherwise arise.

Circuit Element

When the tube is considered as a circuit element (part of a multivibrator circuit, oscillator section, and so forth) the problem of adequate measurements is not so simple. Judgments of tube acceptability must be based on data related to the circuit involved. These data are obviously obtained by measurement of tube parameters. This indicates that a selection must be made of that tube parameter (or parameters) significantly related to the circuit application.

Main Types of Tubes

At present there exists in excess of 1000 types of receiving tubes alone, each differing in some respects. This number includes over 800 multielement tube types—triode, tetrode, pentode, and so forth—used in endless circuit variations. These statistics serve to point out the almost impossible task imposed on
device designed to measure the quality of a tube for a particular application.

In the light of the foregoing, it would seem that the problem of testing a tube to determine its "goodness" for a given usage cannot be answered except by determining solutions to the following questions:

What tube parameter must be measured?

How can this parameter be measured?

Can one testing equipment be employed to measure parameters, independently of others, for all types of, say, receiving tubes?

The mathematical and graphical analysis of vacuum tube circuits and vacuum tubes require the use of certain tube parameters whose numerical values are dependent upon the construction of the tube and upon the electrode voltages and currents. These factors serve as indices of the ability of given tubes to perform specific functions. Certain of these factors, the mutual resistance of the control grid-plate (mutual conductance), are of primary importance in the analyses of tube circuits.

Commercial companies, in their developments to provide servicing gears, provide equipment designed to measure emission and mutual conductance. The quality of a tube as indicated by a measurement of transconductance is sufficient to establish whether the tube performance would be satisfactory when the application is one in, say, audio circuits.

However, important as the transconductance factor may be, it is a lesser factor when the tube is being evaluated for application in a high frequency oscillator. The critical factor in this case is interelectrode capacity, normally controlled by a manufacturing specification.

Again, transconductance is of lesser influence in determining the acceptability of a tube for use in a multivibrator circuit of a computer, where cathode interface resistance is critical.

### Limited Value of Tube Testers

Inasmuch as present-day operating conditions and advanced circuitry require close control over critical tube parameters which do not lend themselves to field measurement, the military tube tester is of limited value as a maintenance device.

Furthermore, many of the current tube testers are inherently incapable of accomplishing the function for which they were designed with any but the most approximate accuracy.

Specifically, it can be concluded that the current military tube testers can be employed as useful maintenance tools only when (1) tube acceptability is to be determined for application in which the parameters of transconductance and emission are significant; and when (2) circuit conditions under which the tube will operate involve voltages not appreciably different from those impressed by the tester. Abstracted from "Field Testing of Electron Tubes, Bureau of Ships, June 1950, page 29."

Hughes has been the leader from the beginning in applying electronic computers to airborne fire control equipment. Today every U.S. Air Force and Canadian continental defense interceptor uses Hughes-developed and Hughes-manufactured systems.

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Write for FREE Bulletin 15-57

Abstract—British

"On-The-Nose"

Described here is a means for accurately tuning in fm signals where ratio detectors are employed.

For undistorted reproduction of fm signals the ratio characteristics should have a flat top a few hundred kilocycles wide. A voltmeter on the ac line, if any, or across the stabilizing capacitor of the radio-detector circuits, will indicate the same maximum reading anywhere on the flat top, giving no guidance to the center point. Also, it will lead to completely unsymmetrical tuning if the if is lossed or dog-eared. This method is commonly used, however, as it permits the use of a "magic eye" indicator which requires an input with one side grounded.

Another type of meter circuit observes the dc voltage at the if take-off point of the ratio-detector. This voltage is positive on one side of the correct tuning point and negative on the other, so that a center-zero meter can be used to find the null point. The disadvantage, apart from the necessity for a center-zero meter, is that the same (zero) reading is obtained on tune and well away from tune, making the reading difficult to interpret.

The circuit in the diagram combines the above two methods to give a meter reading which is a maximum on the exact center of tuning and falls away to zero on each side. Assume R3 disconnected; if a signal is present the meter will read the

<p>| Suggested values for the resistors (all 1/4-W) are: |
|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Meter Sensitivity</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mA</td>
<td>220k</td>
<td>1k</td>
<td>220k</td>
</tr>
<tr>
<td>250 mA</td>
<td>100k</td>
<td>10k</td>
<td>4k</td>
</tr>
<tr>
<td>500 mA</td>
<td>47k</td>
<td>22k</td>
<td>22k</td>
</tr>
</tbody>
</table>
FM Tuning

normal if flat-topped response. If the remainder of the circuit is now connected, any unbalance voltage at the af take-off point will pass an opposing current through the meter, reducing the reading. The current rectifier insure that the current will oppose that through $R_1$ whatever the polarity of the unbalance voltage. If the unbalance is zero, the opposing current is zero and the meter will read a maximum, but the slightest mistune will reduce the reading.

Suitable resistor values are suggested for several meter sensitivities. The rectifier is a 1-ma meter rectifier, commonly found in ac voltmeters.

The purpose of $R_2$ is to prevent the rectifier from shunting away from the meter part of the standing current through resistors $R_1$ and so reducing the maximum possible reading. The extent to which this occurs depends upon the resistance of the meter movement; and the value of $R_2$ should be as low as possible. In some cases it can be zero, and a quick check (with $R_3$ disconnected) will show what is the smallest value which can be used without reducing the reading by more than, say, 10 per cent. $R_2$ should be as high as possible to avoid shunting the output, but higher values will reduce the "sharpening" effect of the unbalance voltage. For this reason 50 microamperes is about the least sensitive meter that can be used.

To decide on resistor values for a particular meter and tuner, first connect only the meter and resistors $R_1$ to the values in the table. Tune in a strong signal and vary the values of $R_1$ (keeping them equal) to give about 60 per cent full scale or whatever is a convenient maximum reading. Now add the rectifier across the meter (the "wrong" way around) with $R_2$ zero. If necessary, insert some resistance at $R_2$ as described above, to avoid a large drop in reading. Finally, connect $R_3$, using for a start a value equal to $R_1$, and try the effect of detuning. If it is not sharp enough, reduce the value to $R_3$.

It may be noticed that the meter reading is a bit unsteady-looking if the tuning is rapidly changed. This is due to the stabilizing capacitor preventing rapid changes of output voltage, although the unbalance voltage changes immediately. In practice, the tuning is moved slowly when approaching proper tune, and the effect is not noticeable.

Abstracted from an article "FM Tuning Meter" by Robert S. Fergurson, Wireless World, July 1956.
Determining Combined Power of Two Signals

This chart simplifies the power addition of two signals whose levels are expressed in db. It is especially useful for determining the resulting power when two sources of cross talk, speech or noise are combined.

To use the chart, locate the db difference between the two known signals on the x axis. Number of db to be added to the larger quantity to get the combined signal level is found on the y axis.

Example

A microwave system producing 26 dba of noise and a cable carrier producing 29 dba of noise are to be connected in parallel. Difference is 3 dba. From the chart, 1.76 dba must be added to the larger quantity. Total noise will be 29 + 1.76 or 30.76 dba.

Material for this article has been furnished through the kind cooperation of Lenkurt Electric Co., San Carlos, Calif.
Inertial Navigation offers the most advanced concept in guidance requiring no terrestrial source of energy or information, no earth-bound direction once the ultimate destination is selected. It offers the most promising solution of the guidance problem for the long-range missile.

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what makes tape wound cores reliable?

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Reliability demands electrical stability through the years. Suppose guided missiles failed to function in a future emergency because the magnetic properties of tape wound cores had changed. Cores must operate just as effectively years from now as they do today, whether or not they have been in use. Vibration, shock, and temperature changes can endanger such performance. That's why Magnetics, Inc. cushions tape windings with a special inert material in the extra-strong aluminum core box. And that's why it is especially important that our tape wound cores enclosed in aluminum boxes will withstand temperatures up to 450° F.

Reliability demands exacting standards on the part of the manufacturer. Judge a product by the company that makes it. Take a company that has pioneered a core box so advanced that it even permits vacuum impregnation. Take a company whose attention to design detail permits the offer of the only Performance-Guarantee in the industry. That's a real definition of reliability. Why not ask us how it will work for you? Magnetics, Inc., Dept. E-32, Butler, Pennsylvania.

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CABLE: MAGNETICS

Industrial Preparedness Studies On Transistors and Rectifiers

Two Industrial Preparedness Studies for the U.S. Army Signal Corps Supply Agency, one on transistors and the other on silicone power rectifiers, have just been released to industry.

Transistors and Transistor Manufacturing Equipment

Purpose was to develop a point-contact switching transistor and a general purpose junction transistor. Necessary manufacturing equipment and facilities were to be designed, built and operated on a pilot run. Volume 1 of this report reviews the engineering development work and summarizes the design features of these two transistors. Pilot production problems encountered were discussed, and complete manufacturing instructions (Standardizing Notices) for both types were included. Volume 2 contains descriptions and photographs of the mechanized equipment developed for point-contact production. Final report. Radio Corp. of America for Signal Corps Supply Agency. May 1955. Two Vols. Vol. 1—PB 111822, 200 pp. $5.00. Vol. 2—PB 111820, 42 pp. $1.25.

Silicon Power Rectifiers

Process improvements, including development of soldering the silicon junction wafer directly to the base and further development on welding the lead at the final sealing operation, have increased the yields and improved the mechanical and electrical characteristics of silicon power rectifiers manufactured according to procedures described in this report. The process used for assembling the rectifiers has proved to be entirely feasible, and the aim of developing it along lines suitable for mass production has been successfully met. A number of processing steps which, at present, are still hand-operated, can be readily converted to automatic techniques. The process is now already partly mechanized, and is rapidly being completely mechanized. This will allow considerable expansion of present production rate. PB 11819 Industrial Preparedness Study: Silicon Power Rectifiers. Quarterly Progress Report. Transistor Electronic Corp. for Signal Corps Supply Agency. Jan. 1955 to Apr. 1, 1955, 33 pp. $1.00.

ELECTRONIC DESIGN • September 15, 1956
solving logical problems with

Burroughs pulse control systems

detecting coincidence between
two random trains of pulses

The diagram below shows a quick, easy logical method of detecting coincidence between random pulses on two different lines—pulses which might occur simultaneously, well within the switching time of even the fastest units. In this case, the system's approach proved to be more feasible than increasing the precision of the components.

Logical problems such as this one still tie up most of today's engineers... making them design breadboard equipment to prove out their solutions... relegating their creativeness to secondary projects. Burroughs Pulse Control Systems cut through these time-consuming operations by giving the engineer a quick, logical method for checking his results.

Each unit in the Burroughs System represents a basic logical function. The engineer has only to hook up a number of these units to correspond with his block diagram, and the solution is ready for proof. Intermediate breadboarding is completely eliminated... his concept is proved or disproved quickly... and he is free to concentrate on the end result.

You can give your engineers this creative edge by letting Burroughs Pulse Control Systems take over the burden of proof. A Burroughs engineer will be glad to call on you—at your convenience—and show you how to save hours of engineering time and production headaches. Or, write for Bulletin 236.
In offering these frequency meters we have endeavored to bring to the electronics industry instruments for frequency measurement which are fairly priced yet without sacrificing a high degree of accuracy resulting from precision manufacture. The frequency determining element of these instruments is a cylindrical resonator with a tuneable choke plunger that provides a smooth and accurate interpolation of frequency. Four models are offered, each model covering a wide frequency range and employing standard waveguide and flanges. Three types, described below, are offered in each frequency range. All models have been designed to use the standard FS Model M-1000 Microwave Head which has been widely accepted by the electronics industry. Construction is of Invar and accuracy is .01% under laboratory conditions.

<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency Range</th>
<th>Waveguide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models 8211-3</td>
<td>8200 to 11500 MC</td>
<td>RG-57/U</td>
</tr>
<tr>
<td>Models 7010-3</td>
<td>7000 to 10000 MC</td>
<td>RG-51/U</td>
</tr>
<tr>
<td>Models 5882-1, 2, 3</td>
<td>5800 to 8200 MC</td>
<td>RG-50/U</td>
</tr>
<tr>
<td>Models 4458-1, 2, 3</td>
<td>4400 to 5800 MC</td>
<td>RG-49/U</td>
</tr>
</tbody>
</table>

**Abstract**

LACK of completeness, difficulty of control, confusion, and discouragement of higher quality are the four major pitfalls which may occur when the electronic designer-buyer prepares procurement specifications for the material which he buys, according to the Engineering Department of Radio-Electronics-Television Manufacturers Association. These pitfalls arise from the inability of the customer to prepare a complete spec for lack of detailed knowledge of the product, or the parameters which he uses to describe the product may not be feasible of verification or control. In addition, several consumers may be buying the same product, yet each describes it in his own terms. This may create extensive problems in production, stock control, and the provisioning of spare parts. Use of a consumer's spec often encourages the procurement of the cheapest product which will apparently meet the stated requirements. This condition arises from the buyer placing the responsibility on his incoming inspection to meet the effective quality.

One of RETMA's solutions to this expensive and time consuming method of procurement is to have the buyer arrange to make maximum use of the seller's test facilities by means of a mutually agreed upon, certified, test program. The product must conform en masse to the mutually agreed upon requirements. Lots or shipments which contain a significant degree of non-conformity should be considered unacceptable as a whole. In order to make such a plan workable and economical, some allowance should be made for non-conformity by means of an Acceptable Quality Level (AQL).

The AQL is defined as the maximum percent defective or the maximum number of defects per unit which can be considered satisfactory as a process average; i.e., it is the poorest quality which a supplier can be permitted continually to present for acceptance.

RETMA further recommends that, since it is far too expensive and time consuming to calculate the optimum AQL for each individual procurement and since industry standards are being established by
Quality Acceptance

negotiations between groups of producers and consumers, these industry standards be used as much as possible.

The AQL should form a part of the purchase spec either directly or by reference to a recognized standard. It should appear either on the purchase order, or piece part print, or a supplementary spec, etc.

Inspection may be done in any manner jointly agreed upon previously. Some of the more common types of agreements are: final inspection and acceptance at the vendor's plant, final inspection and acceptance by buyer or vendor certification.

Perhaps even more important than where the inspection takes place is the type of inspection to be performed. Basically, there are two methods of inspection, inspection by attributes, where conformance to a characteristic of the unit being inspected is judged only by whether it is within or outside its prescribed requirement, and inspection by variables, where conformance to the requirement is judged from the actual measured values which are also summarized or plotted for use in engineering analysis or process control.

The acceptance inspection of material produced in volume divides into two broad classes, detailed inspection and acceptance sampling, either of which may be made by attributes or variables.

Clear definition of the sampling needs will indicate the preferred type of sampling plan. Details of sampling can then be determined from the magnitude of the defect content and the level of statistical proof required. Clear definitions, classification of defects, logic, statistics analysis, and sampling tables are the major tools needed.

Abstracted from RETMA Quality Acceptance Bulletin No. 1, entitled "Acceptance Agreements," Bulletin No. 2, entitled "Acceptable Quality Levels and How They Are Set Up," and Bulletin No. 3, entitled "Introduction to Sampling." Copies of each of these Bulletins and others to be issued are available from the Engineering Department, Radio-Electronics-Television Manufacturers Association, 11 W. 22nd St., New York 36, N.Y., for 25 cents each.

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CIRCLE 376 ON READER-SERVICE CARD FOR MORE INFORMATION
DEVELOPMENTS of components and circuits intended primarily for inclusion in digital computers, has focused much attention on the possibility of utilizing a square hysteresis-loop, ferromagnetic toroidal core as the primary logical element in these computational circuits.

In this paper, the data gathered through a survey plus the author's own work in the field, has been set down to explain the use of magnetic core logical circuitry in the digital computation field.

**Characteristics of Square Hysteresis-Loop Magnetic Material**

Fig. 1 shows the B-H curve of a typical square hysteresis-loop ferromagnetic material. If the material is magnetized at the point on the loop marked +B, and is subjected to a negative magnetizing force of value $-H_m$, it will traverse the path in the direction of the arrows to the point of 0. There will be a large change of flux. Then, when the magnetizing force is withdrawn, the material will return to the point shown by the $-B_r$. If, on the other hand, the material is at the point $-B_r$ before the magnetizing force $-H_m$ is applied, then upon the application of $-H_m$, there will be only the slight flux change, and the ferromagnet will then return to $-B_r$. These two states, corresponding to $+B$ and $-B_r$, can be used to represent the binary states ONE and ZERO respectively.

All that is needed to detect the condition of the material is a winding which links the flux. Then if the substance contains a ONE when it is driven to 0, there will be a large flux change and a corresponding large voltage across the winding, whereas if it contains a ZERO then only a small voltage appears across the winding.

In the operation of the Wang-Woo delay line, Fig. 2, an information pulse would be inserted into core 1, then an advance pulse would transfer it out of core 1 into core 2 to make room for the next information input. A second advance pulse would transfer it from core 2 to core 3, and core 1 would be ready to receive the next bit of information. The advance pulses would continue cyclically and when the first bit of information reached the end of the delay line it would be read out. If the advance pulses were halted with the information still in the delay line, information would remain there indefinitely or until the advance pulses recommenced. If the output of the delay line was connected back to the input, then the information would recirculate and be available for sampling at any desired time, much on the order of the magnetic drum or tape storage.

**Two Core Per Bit Magnetic Shift Registers**

An important advance in the design of magnetic shifting registers came in the form of the two-core-per-bit transfer loops. These loops eliminated the extra core shown in the earlier three core per bit forms and, at first, utilized a shunt diode to short out the current when there were two cores connected to the common inputs of the cores.

With this arrangement, and with the input being arranged so that the major loop was unidirectional, all information in the two cores was shifted from one to the other by a single pulse applied to the common inputs of the cores. This arrangement of a pair of cores with a shunt diode and without an inductor, proved impracticable, particularly when it was necessary to transfer the information back from one end of the line to the other.

**Fig. 1. Hysteresis loop of ferromagnetic core material.**

**Fig. 2. Wang-Woo magnetic delay line.**

**Fig. 3. Shunt diode, two core per bit shift register.**

**Fig. 4. Biased diode transfer loop.**

**Fig. 5. One core per bit transfer loop.**
current which would tend to transfer information backwards. A circuit of this type is shown in Fig. 3. The two-core-per-bit or double line registers are superior to previous forms in speed of operation. These registers have been run at information rates above 250 kc.

With the development of production type germanium diodes, the selenium diodes were replaced and frequency began to increase. It was discovered that by utilizing proper design techniques, the number of turns on various windings about the transfer loop could be so adjusted as to make the shunt diode unnecessary.

All magnetic core logical elements with several output windings per core generated output voltages on each of the output windings when the core was interrogated by a reading pulse. It was not possible, using these elements, to read out information into separate, specified circuits from the same core at different times.

Gated diode circuits are capable of effecting a conditional transfer into one of the several specified output circuits about an element, or of the allowing transfer out of an element only upon a particular condition, regardless of the polarity or amplitude of the input signals. They achieve this conditional transfer type of operation through the placement of two diodes in the transfer loop between the elements, Fig. 4. The diodes are arranged in such a way that the cores are linked electrically only when a current generated by some external source is passed through the loop.

One Core Per Bit Magnetic Shift Registers

In the shift registers described so far, the information and storage transfer has always required use of two or more cores per bit. At any instant, one core could be considered a permanent storage and the other a temporary storage. Two separate phases of advance pulses were required. By utilizing the temporary storage properties of a charged capacitor, one core per bit operation has been achieved. In this scheme, Fig. 5, a single advance pulse line is used to saturate all cores in the magnetic shift register simultaneously to the ZERO state. Those cores which were previously in the ONE state charge their associated condensers through a diode. After the advance pulse has ended and the condensers have been fully charged, they discharge through the series resistors and input windings of the immediately following stages to read ONES into the cores. The information is advanced one stage with each application of the advance pulse. This means one core and one diode per bit of information stored.

This report also discusses ferromagnetic core logical systems. Included in the discussion are gates, timing pulses, adders, magnetic decision elements and transistor core circuits. Abstracted from PB 111954 Ferromagnetic Core Logical Circuity and Its Applications to Digital Computers. A. J. Lincoln, Ballistic Research Labs, Aug. 1955.

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The Model 111 incorporates KAY LAB's proven chopper amplifier circuitry and provides ten extremely precise feedback controlled gain ranges. Several feedback loops ensure high accuracy, stability, and uniform frequency response. The completely new and unique circuit provides rapid recovery from severe overloading and unsurpassed dynamic performance - unaffected by load or gain changes.

The Model 111 is available in a single-unit cabinet or in a six-unit rack-mountable module. The amplifiers are extremely compact, the six-unit module occupies only a 15 inch rack width.

APPLICATIONS: The Model 111 is ideal for permanent low level dc instrumentation, telemetering, or as a strain gage amplifier, transducer amplifier, scope preamplifier, recorder driver amplifier, or general purpose laboratory amplifier.

**SPECSIFICATIONS**

- **Gain**
  - 0, 20, 30, 50, 70, 100, 200, 300, 400, 700, 1000
  - \( \pm 1\% \) DC to 2 KC

- **Gain Accuracy**
  - \( \pm 0.0001\% \)

- **Input Impedance**
  - 100,000 ohms

- **Output Capability at DC**
  - 0 to \( \pm 35 \) V where RL \( \geq 1000 \) ohms
  - 0 to \( \pm 40 \) MA where RL is 10 to 400 ohms
  - Less than 1 ohm in series with 250 ohms

- **Output Impedance**
  - \( \leq 2 \) ohms with regulated line
  - \( \leq 0.003 \) ohms at 1,000 ohms

- **Equivalent Input Drift**
  - 0 to 3 cpm, less than 5 pm peak to peak
  - 0 to 750 cps, less than 5 pm RMS
  - 0 to 50 kc, less than 12 pm RMS
  - Less than 0.1% at 2 KC

- **Chopper Intermodulation**
  - Better than 0.1% at 2 KC

- **Linearity**
  - Better than 0.1% at 2 KC

- **Frequency Response**
  - \( \pm 3 \) (0.3 db) DC to 10 KC, less than 3 db down at 40 KC

- **Power Requirements**
  - 117 V - 60 cycles - 70 VA
  - 117 V - 60 cycles - 15 VA
  - 117 V - 60 cycles - 45 VA

- **Dimensions, Amplifier Unit**
  - 2 1/2" wide, 7 1/2" high, 14 3/4" deep

- **Net Weight - Amplifier**
  - 11 pounds

- **PRICE:** Amplifier Unit
  - $550.00

- **19-inch Rack Adaptor for 6 Amplifiers**
  - 19" wide, 8 1/4" high, 18 1/4" deep

- **Cabinet for single amplifier**
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**Standards and Specs**

Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industrial standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

**Aircraft Electronics**

ANA BULLETIN No. 400g, APPLICABLE DOCUMENTS FOR AIRCRAFT ELECTRONIC EQUIPMENT, 1 March 1956

The latest effective issue of specs, standards, drawings, and publications to be used in the design and construction of airborne electronic equipment are listed by this Air Force-Navy Aeronautical Bulletin. The use of this list is governed by MIL-E-5400.

MIL-E-5400 (ASC), GENERAL SPECIFICATION FOR AIRCRAFT ELECTRONIC EQUIPMENT, Notice 1, 10 February 1956

The general requirements for the design and manufacture of airborne electronic equipment for operation primarily in piloted aircraft are covered in this spec. The detail performance and test requirements for a particular equipment are still specified in the detail spec for the equipment. Unless otherwise stated in equipment specs, requisitions, drawings, contracts, or orders, all equipment shall be designed for 50,000 feet altitude and continuous sea level operation over the temperature range of \(-55^\circ C \) to \(+55^\circ C\).

**Audio Cable Insulation**

MIL-C-3883, AMENDMENT 1, CORD, ELECTRICAL (AUDIO FREQUENCY), 20 June 1956

All references to the properties, test requirements, and test methods relating to insulating and jacketing compounds, formerly described in the body of the spec, have been deleted and replaced by references to MIL-I-3930, Insulating and Jacketing Compounds, Electrical (for Cable, Cord, and Wire). Three spec sheets have been revised to specify the particular type of Buna-S material, as indicated in MIL-I-3930, for the insulation and shield jacket.

**Transformers**

MIL-T-27A, SUPPLEMENT 1B, TRANSFORMERS AND INDUCTORS (AUDIO, POWER, AND PULSE), 28 June 1956

Supplement 1B includes additional "MS" Military Standards covering nine different types of audio-frequency transformers.

ELECTRONIC DESIGN • September 15, 1956
Semiconductor Symbols

56 IRE 28, S1, LETTER SYMBOLS FOR SEMICONDUCTOR DEVICES, JULY 1956
A uniform system of letter symbols for electrical quantities and parameters as applied to semiconductor devices is provided for by this standard. This standard is supplementary to the IRE Standards on Abbreviations, Graphical Symbols, Letter Symbols, and Mathematical Signs—1948, Section I. The usage conforms to Section 101, General Principles of Letter Symbol Standardization. The standard has been divided into three sections: 1) electrical quantities, dealing primarily with voltage, current, and time quantities; 2) electrical parameters, dealing with the relationship between specific electrical quantities; and 3) a list of letter symbols in alphabetical order. Copies of this standard may be obtained from the Institute of Radio Engineers, 1 E. 79th St., New York 21, N.Y. for $0.50 per copy.

Electrical Cable Insulation

MIL-C-3884, AMENDMENT 1, CORD, ELECTRICAL (SHORT LAY), 20 JUNE 1956
All references to the properties, test requirements, and test methods relating to insulating and jacketing compounds, formerly described in the body of the spec, have been deleted and replaced by references to MIL-I-3930, Insulating and Jacketing Compounds, Electrical (for Cable, Cord, and Wire). The typographical error concerning the procedure for breaking the load of the core has been corrected. Three spec sheets have been revised to specify the particular type of Buna-S material, as indicated in MIL-I-3930, for the insulation and shield jacket.

Receiver Requirements

Recommended Methods of Measurement on receivers for Frequency Modulation Transmission was authorized for publication by the International Electrotechnical Commission as the result of the ten-day conference held June 29 through July 6, 1956 in Munich, Germany. A document on radiation measurements was accepted for circulation. The committees acted in favor of a document on the method for testing for volume and surface resistivities of insulating materials. A publication on primary cells and batteries was also approved for publication. The 1957 meeting of the IEC will be held in Moscow, where delegates will be the guests of the U.S.S.R. National Committee of IEC from July 2-12. The International Electrotechnical Commission, which develops standards in the field of electrical engineering and communications, is a federation of the national committees of 32 countries. The United States National Committee of IEC is an arm of the American Standards Association.

Let's look at it this way—What features should an instrument incorporate to make your job easier, help prevent costly mistakes? Take the case of the new PRD Klystron Power Supply. Should we incorporate a sawtooth rather than a sine wave modulation? It's easier to put in a sine wave. However, a sawtooth has the definite advantage of eliminating phasing and blanking problems when the frequency response of a transmission device is to be studied. So, in goes the sawtooth. It's easy enough to get hold of some sine wave modulation which can be applied through the external modulation input.

As for preventing mistakes—consider switching from cw to square wave modulation. Suppose you forget to readjust the reflector voltage... Sure, you'll catch the mistake later, but time is lost. The new PRD Klystron Power Supply has an electronic clamping circuit which locks the top of the square wave to the previously chosen reflector voltage. No readjustments to think about, no mistakes.

Want to modulate with pulses—use the external input. The rise time degradation of your pulses will be less than .1 microsecond!

Another point, good regulation! Here's an example: a ±10% line change or any load change will cause a reflector voltage change of only ±.01%.

Compare... chances are that you'll send in your order for the PRD Type 809, too.

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CIRCLE 380 ON READER-SERVICE CARD FOR MORE INFORMATION
The manuals and data sheets of a number of leading electron tube manufacturers suggest Tempilaq® as a convenient means of determining operating temperature characteristics.

Some of the problems in the electronic field for which Tempilaq® has been found very useful are:
- Monitoring metal-to-glass seal temperature of electronic tubes.
- Safeguarding television camera tubes against overheating.
- Checking baking temperature of television picture tube bulbs.
- Monitoring temperature rise of transmitter tubes.
- Finding causes for tube failure.
- Checking temperature rise of rheostats.
- Testing current carried by resistors.
- Determining operating temperatures of industrial x-ray machines.
- Signaling overheating of power switches and electrical apparatus generally.

Let us cite some typical applications of Tempilaq® for customers’ letters:

1. “We have used Tempilaq® during the development of a transmitter. Cooling of power tubes, inductors, and other components under operating conditions needed to be carefully evaluated. Tempilaq® temperature indicators proved to be a practical method of checking the operating temperature of these critical items.”

2. “Tempilaq® was used to determine the maximum operating temperature of the metal-to-glass seal in a vacuum tube (Type 2C39A) operating in a high power coaxial circuit. The manufacturer’s maximum recommended operating temperature of this seal was 350°F. As insertion of an external thermocouple to measure the temperature would have disturbed the electrical operation of the circuit, we used your Tempilaq® instead to fix the maximum temperature range reached by this seal. This test gave us assurance that we were adequately cooling the tube and keeping it within manufacturer’s ratings.”

3. “...This then was the problem—to find a radiator which was light, small, and would still dissipate a quantity of heat sufficient to keep the x-ray tube at normal operating temperatures. Temperature measurements of the radiator by direct reading instruments was impossible because of the high voltage (125KV to ground) present on the radiator.

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By correlating the time lapse of any one operational setting of the machine and noting the highest melted line as well as the lowest un-melted line, we were able to tell within a few degrees the equilibrium temperatures of the radiator. The experiment proved to be quite to our satisfaction.”

Tempilaq® consists of materials of calibrated melting points, suspended in volatile, non-flammable liquid. There are some sixty different Tempilaq® coverings, ranging from 103°F to 2000°F, each indicating a specific temperature, with an accuracy of plus or minus 1%.

Tempilaq® may be applied by daubing, brushing, dipping or spraying, and can be thinned to required consistency with Tempilaq® Thinner. Tempilaq® dries within hours after application to a dull, opaque film which retains its mat appearance until its temperature rating is reached, when it liquefies sharply. On subsequent cooling the Tempilaq® film solidifies with a glossy appearance which clearly shows that melting had occurred.

A thin temperature-sensitive film can be applied by spraying well diluted Tempilaq® on with an airbrush. A fine haze will often suffice to provide a visible coating on clear glass or on other polished surfaces. Melting can be recognized by the developed transparency which lets the background show through. This “fine haze” technique is recommended for application on clear glass subjected to radiant heat, in preference to using a heavy coat of Tempilaq®. The latter would absorb radiant heat and cause an abnormal temperature rise in the covered area. The use of a light, almost transparent film of Tempilaq® minimizes such localized temperature gradients.

Half-ounce samples of Tempilaq® can be obtained by writing to TEMPILAQ CORPORATION at 132 West 22nd Street, New York 11, N. Y. Be sure to specify the temperature rating of interest to you and whether Fahrenheit or Celsius.

ASA Standards

ASA has recently announced the approval of the following new standards:

C61.1-1956, TERMINAL MARKINGS FOR ELECTRICAL APPLIANCES
C33.3-1956, SAFETY FOR CORD SETS AND POWER-SUPPLY CORDS
C33.4-1956, SAFETY FOR SPECIALTY TRANSFORMERS
C033.5-1956, SAFETY FOR WIRE CONNECTORS AND SOLDERING LUGS

ASA Membership Directory

The 115 national technical societies, trade associations, and public interest groups, and the 2300 companies which are affiliated with ASA are listed in a new 63-page booklet, entitled “Directory of the Members of the American Standards Association.” It also names the officers and the Board of Directors of the Association. The booklet also gives the state and city governments, colleges and universities, and various individuals affiliated with ASA. Copies of the booklet are free upon request from Dept. PR, American Standards Association, 70 E. 45 St., New York 17, N. Y.

ASA Standards Information

The three ways that standards become nationally accepted and approved as American Standards are described in a 19 page booklet issued by ASA. It tells who makes these standards and why, and who uses them. The booklet also explains who ASA is, how it guards the democratic processes through which American Standards are developed, and how it operates impartially for the manufacturer, the consumer and the general public. Included in this booklet is a glossary of terms that are likely to be met when discussing or formulating standards under the procedures of ASA. Copies of this booklet, entitled “How American Standards Are Made,” may be obtained without charge by writing Dept. PR, American Standards Association, 70 E. 45 St., New York 17, N. Y.

Resistors

MIL-R-26C, RESISTORS, FIXED, WIREWOUND (Power Type), 28 June 1956

All 31 spec sheets formerly included with MIL-R-26B have been cancelled. The following 17 styles of resistors have been retained: RW20, RW21, RW22, RW23, RW24, RW25, RW30, RW31, RW32, RW35, RW36, RW37, RW38, RW47, RW57, and RW66. The requirements for these styles now appear as figures in the body of the spec. The styles have been deleted in the newly issued spec.
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- Preset Trigger: Optimum setting for automatic stable triggering.
- Input Amplifiers: Sensitivity 1 mv/cm to 50 v/cm; 14 ranges, continuous vernier. Pass band dc to 100 KC.
- Amplitude Calibration: 1 KC square wave. 5% accuracy.
- Price: $450.00.

**hp-1 50A**
- Sweep Range: 0.02 psec/cm to 15 sec/cm.
- Calibration: 24 sweeps/c to 1-2-3-10 sequence, 0.1 psec/cm to 5 sec/cm. 5% accuracy.
- Triggering: Internal, line voltage or external 0.5 v or more. Pos. or neg. slope ±30 to ±30 v trigger range.
- Preset Trigger: Same as hp-1 50A.
- Horizontal Amplifiers: Sensitivity 100 mv/cm to 25 v/cm.
- Vertical Amplifiers: Pass band dc to 100 KC. Optimum transient response and rise time less than 0.035 sec. Signal delay of 0.25 sec permits leading edge of triggering signal to be viewed.
- Amplitude Calibration: 18 calib. voltages, 2-5-10 sequence, 0.2 mv to 100 v peak-to-peak. Accuracy 3%. Approx. 1 KC square wave, rise and decay approx. 1.0 psec.
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For technical data on Oscillograph Tubes, write RCA, Commercial Engineering, Section 1-E-P2 Harrison, N.J.